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A Precision Square.
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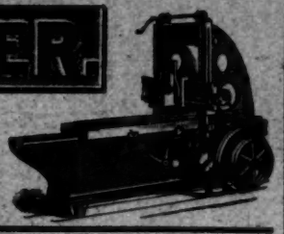

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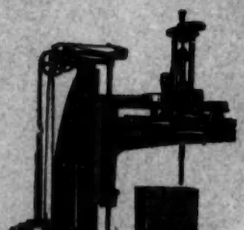

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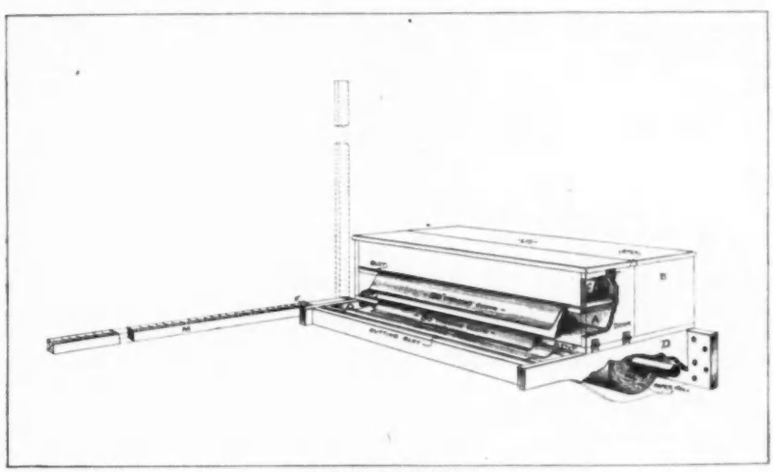
The Gates Iron Works Drawing Room.

BY JOHN RANDOL.

The modern machine-shop drawing-room is making steady progress towards a uniform standard. The last five years have seen great advances in this direction, and there is now so little variety in drawing-room methods and appliances in use in well-regulated establishments that any decided novelty becomes very noticeable; and when, as in the present case, the novelties rise to the dignity of original inventions, resulting in real improvements capable of extended use, the diversion from usual practice becomes particularly striking.

I do not intend to say that the minor human prejudices are in any danger of losing their supremacy to the extent of permitting chief draftsmen to adopt standard sizes of drawings, or uniform systems of lettering and figuring drawings, so that the drawings which are constantly passing from shop to shop in the course of business shall be perfectly convenient in use and keeping wherever they are. The chief draftsman must, in the nature of things, approach the artist in temperament and egotism; and, hence, the better the chief, the more likely the drawing room under his control to exhibit eccentricities and deviations from the normal. Such individualisms are unavoidable, are often valuable, and in some instances are of such general value as to fully warrant publicity.



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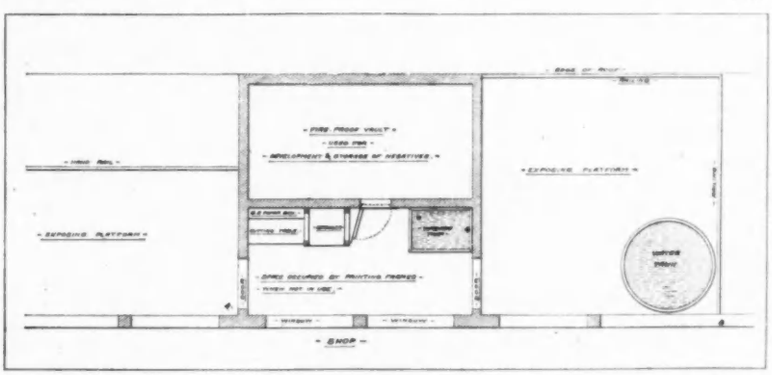
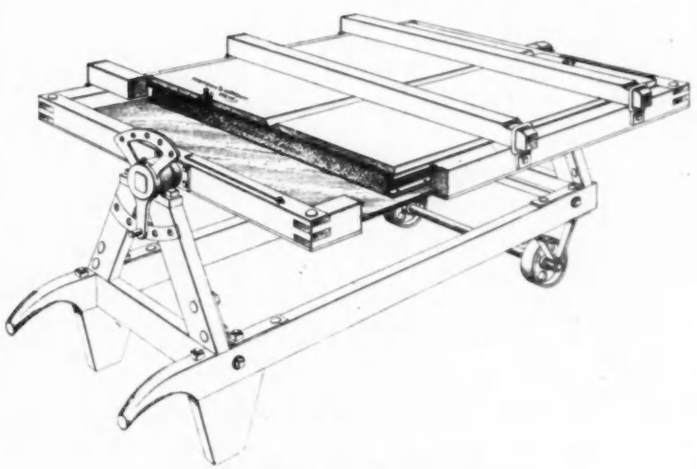


PLAN OF ROOM.

The Gates Iron Works drawing room, in charge of Mr. C. L. Carman, is, as a matter of course, located on the north side of the building, on the office floor, because such is the only correct location for the drawing room of a middle-size shop, and the "Gates," being built all at one time, and under advisement of the heads of all departments of a successful going concern, could not have an incorrectly and inconveniently located drawing room. The Gates blueprint room is on the roof, above the drawing room, so that there is abundant light, and access is had from the drawing-room floor, very near



PNEUMATIC BLUE-PRINT FRAME.

the drawing-room entrance, by a balanced elevator, hand-operated by a rack and pinion lift, which is very easily worked, and makes it almost as easy to go from the drawing room to the blueprint room as if both were on the one floor, while the roof location makes all lights equally available.

The first convenience of the Gates drawing room, in point of sequence, is the paper cabinet and paper-measuring and cutting device. In some large and otherwise very well-arranged drawing rooms, the paper is exposed to dust, and is so handled as to make some waste likely at the cutting of each sheet. By the use of the "Carman Cabinet," the paper is covered, one edge being exposed far enough so that it can be readily drawn out over a measuring scale, and a guiding groove in line with the zero of the scale guides the cutting knife, so that waste can occur through gross carelessness only.

The method in this drawing room is to use paper for sketches and pencil drawings; the drawings are traced on cloth of two widths, 36 inches and 30 inches. In the Carman cabinet the heavy roll of paper is carried on a pole—a curtain pole—passing through holes in the brackets which project outward from a vertical backing piece screwed to the wall of the drawing room, and the leading edge of the roll of paper is brought up through a slit in the box in front, all as clearly shown in the drawing, so that it can be grasped by the hand, drawn out to the required length on the scale, and cut off quickly and at right angles by passing a pocket knife blade along in the guiding slot; the scale is pivoted, and, when not in use, turns up against the wall. The two widths of tracing cloth are carried in two compartments rising above the paper roll, to which compartments access is had through a bottom-hinged door in front; the rolls of tracing cloth are not carried at all; they simply lie in their compartments, with their leading edges exposed, as shown in the engraving. This engraving, and the others not from photographs, are accurate reproductions of drawings which Mr. Carman very kindly furnished, at my request, for use in this article, and they very fairly illustrate the style of work which Mr. Carman thinks it economical to produce. Very much of Mr. Carman's detail work is slightly surface-shaded and margined, giving a clearness to the detail sheets which is very often lacking in shop drawings. Many shops do not use surface shading, except for finished views, but there can be no doubt of the advantage of a certain degree of pictorial effect in detail drawings, and my own practice on the drawing board has always leaned toward the old "coast line" of the camel's-hair days, and there are many chief draftsmen who look with lenient eyes on the few quick pen strokes by which a good draftsman can indicate the contour of a detail. It is true that in some excellent establishments not a single pen mark beyond outlines and section hatching is permitted, yet I believe that, given really good men at the board, Mr. Carman's idea of pictorial effect is conducive to economy, as well as clearness of representation. In a private letter accompanying the drawings, Mr. Carman writes: "We pay our draftsmen good wages, and have none but good men. A cheap man is worse than no man." Hence, good effects with small time expenditure.

From the cabinet the paper goes to the drawing tables—also creations of Mr. Carman. These drawing tables are supported on two gray iron legs, and their entire construction is so well exhibited in the half-tone reproduction of the photograph that no detailed description is needed. There is no adjustment for hight; the table angle is adjusted by the screw, hand wheel nut and pivoted table top batten, or bracket, as shown; the wood top is cut to prevent warping, and is also screwed to two heavy wooden battens, and is provided with a capacious drawer. The table is extremely rigid, and fully equal to supporting the thoughtful pose of a 200-pound artist on a hot summer's day. The want of vertical adjustment in these drawing tables is noticeable. Mr. Carman writes: "Before adopting this non-elevating board, I went around the drawing room and measured all the hights of all the boards, and found the variation less than one inch; some of my draftsmen are six feet tall, and some are about five feet; this convinced me that hight adjustment is more a superstition than a requisite of a correct drawing board." And consequently the very simple and substantial construction shown was adopted, to the entire satisfaction of everybody concerned.

So far, Mr. Carman's working details of the drawing room show merely that sound engineering judgment which his position demands. But when it came to fileing, storing and preserving tracings, he had an inspiration.

The practice of keeping the expensive, almost priceless, tracings which constantly accumulate in the ordinary course of a machine business, in chests of shallow drawers, where they are regularly thumbed and dog's-eared to destruction, is so common and so firmly established that it takes a stout heart indeed to admit the possibility of betterment in this direction. But Mr. Carman produced a method so infinitely superior to anything before known that he will find few imitators, probably, although his method has the vast advantages of low first cost, great economy of space, safety from fire, extension of capacity at will, and absolutely perfect accessibility, and absolutely perfect preservation of the tracings. The method is simplicity itself, and, stated in broad terms, is the practice of the most slovenly and deplorable of the old-time shops; Mr. Carman simply rolls up his tracings, and then piles the rolls on top of each other.

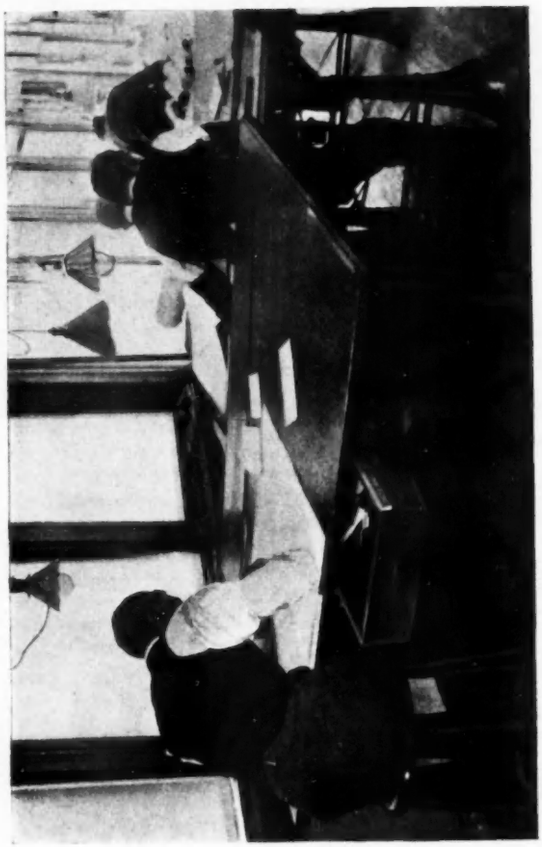
But before he piles them up, he puts them in paper tubes—those of each machine in a tube by themselves often, not always—and puts a cork in each end of the tube; one glued in place, and one pushed in, with a screw eye to pull it out and a cord to maintain an inseparable connection between the tube and cork when the cork is taken out. The tracings are numbered consecutively, and are book-indexed. Mr. Carman confesses this error, and says a card index is superior—which it is, infinitely—and nothing but a card index should ever be used.

TRACING TUBE.

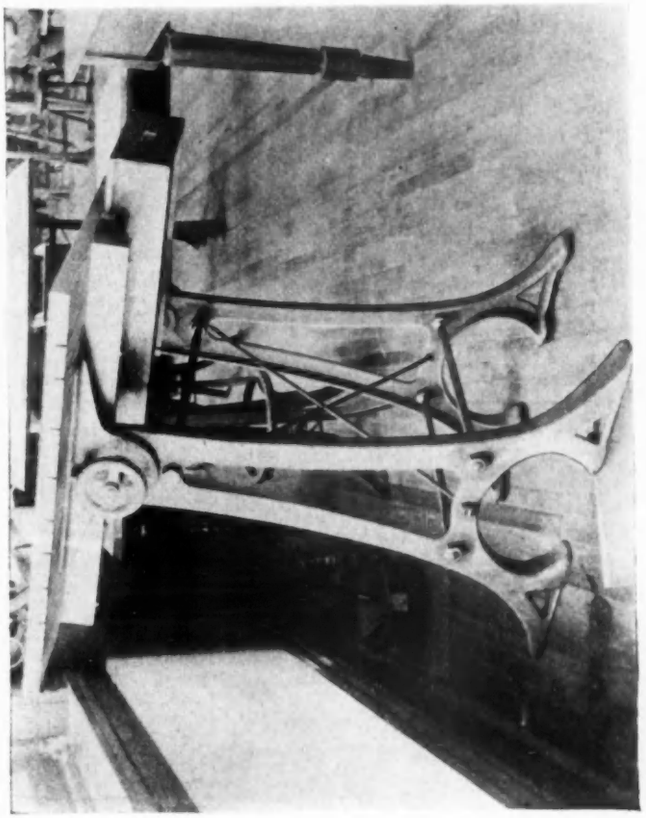
Each cork has its own number; and when stored away, as shown in the engraving, any one of thousands of tracings can be found and reached and looked at in a very small fraction of the time required with any other method of storing I have ever seen. As for space, I do not think one-tenth part so much room is required as would be needed with the chests or "cabinets" of sliding drawers in common use for holding tracings. And to think of standing still, almost, and being able to lay one's hand on any tracing in the shop! It is incredible. Yet it is all true, and when the tube is in hand, it is taken to a table, the tracings slipped out, examined, returned, corked up tight, away from light and that dust which is present in every room occupied by man, and put back in the vault, all so readily as to make the cabinet of drawers seem a relic of barbarism.

To make this description of the Gates drawing room worthy of its subject, a plan of the blueprint room and platforms is given; this needs no explanation more than to say that the water tank is there only because it *is* there, in fact, and has no direct connection with the blueprint room, which is watered through city water pipes. The "Growler" is the rack and pinion hand-driven elevator, previously specified.

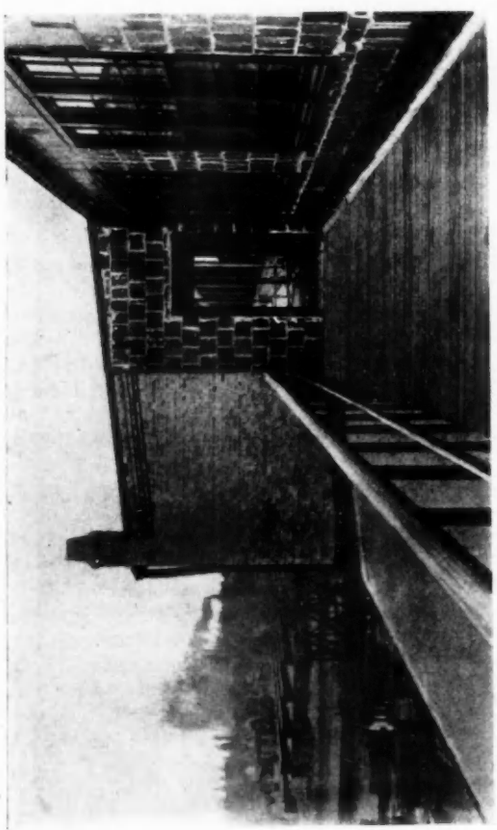
In the blueprint frame, Mr. Carman has mounted the whole structure on a truck, so that it can be placed at right angles to the sun's rays, and be trundled in and out of doors readily. He has thrown away all the time-honored annoyances of felt blankets and spring covers, and substituted a simple form of bellows, or rubber-bag print presser, which insures absolutely certain contact of tracing and paper at every point, which the springs and felt blanket never gave, and which the occasional application of a bicycle tire-inflating air pump to the "Morgan and Wright" valve, indicated in the engraving, insures with the "Carman Pneumatic."



DRAWING TABLE IN USE.



DRAWING TABLE.



BLUE-PRINT ROOM.

FIREPROOF VAULT—STORED TRACINGS.

The bellows is made of thin, flat rubber, put together with battens in the manner clearly shown, and is also cemented, and is so tight that the pressure stays up for weeks. The cover battens are hinged at the rear, and latched down when in use with hinged stirups in front. The front half of the cover is screwed to the battens; when the battens are lifted to 45 degrees or so, they can be fastened up with the long hook rods eyed to the end rails, so as to keep that position; then the tracing and paper can be readily slipped in under the bellows. The whole affair is decidedly better than anything I have ever seen before. The drawings are so good that little need be said in explanation.

To clean tracings, Mr. Carman lays them on a sheet of blotting paper, and goes over them with benzine and a sponge. This cleans them perfectly, and does not injure the tracings in the least.

The thanks of our readers are certainly due to Mr. Carman for his clever drawing-room inventions, and for the five drawings, which he has furnished to illustrate them, and there are a great many drawing rooms in which some of Mr. Carman's new ideas might be adopted with decided advantage.

A "Precision Square."

The ordinary try square indicates plainly enough when a piece of work to which it is applied is out of square, provided a good light is obtainable; but when the variation is very slight, the light must be a strong one, and the amount of variation must always be estimated; it is not directly indicated.

We present herewith drawings of a square which is much less dependent upon strong light—i. e., a square which does not require that light shall shine directly through between the blade and the work, and one which, while it still leaves the variation from the true right angle to be estimated, very materially assists in estimating correctly.

The square is the invention of a well-known mechanic, Mr. G. A. Bates, 20 Ryerson street, Brooklyn, N. Y. The blade is pivoted at *A*, Fig. 1, and can move through a small arc. In doing so, it moves an indicating lever *B*, which is pivoted at *C* and connected to the blade at *D*; the result being that when the blade is moved in one direction, the lever moves in the opposite direction, through a much greater arc, and the variation between the two lines shown—one drawn upon the upper end of the lever, and the other on an adjustable plate attached to the blade—is many times the variation of the work from a true right angle, and the slightest variation is very readily seen, even when it is difficult, or even impossible, to see between the blade and the work, as is required to be done with the ordinary square. At the same time, when it is desirable to clamp the blade, either square with the stock or at a slight angle to it, as is sometimes required, it is readily done by simply turning the knurled screw *E* at the end of the stock, the action of this screw upon the clamping lever *F* being clearly indicated in Fig. 1. It is needless,

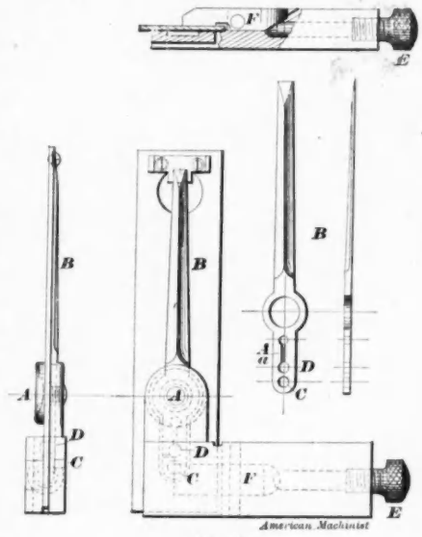


Fig. 1

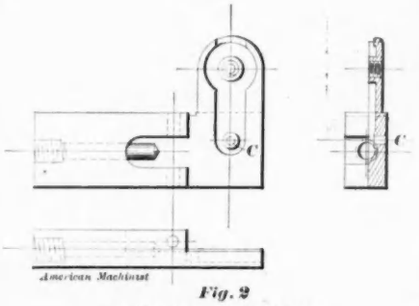


Fig. 2

A PRECISION SQUARE.

perhaps, to remark that the clamp has not the slightest tendency to disturb the adjustment of the blade.

To insure that there shall be no lost motion in the connection between blade and indicating lever, the pin which connects them is fixed in the blade, and the

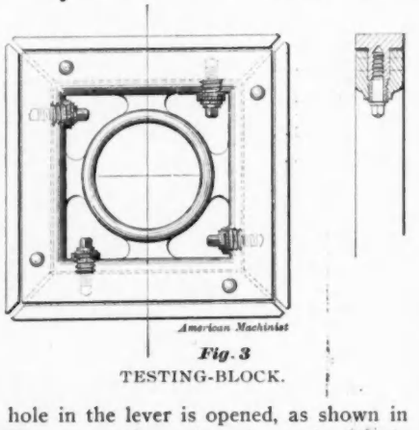


Fig. 3

TESTING-BLOCK.

hole in the lever is opened, as shown in Fig. 1, and the spring piece *a* is slightly depressed, so that it always bears snugly against the pin. The corner between the blade and stock is opened slightly, as shown, so that trouble from dirt collecting there is avoided. Fig. 2 shows the stock separately.

In using a sample square, from which our engravings were prepared, Mr. Bates found it to be capable of standing tests of very great refinement, and at Fig. 3 we show a device gotten up for testing and adjusting the square. It is called a testing block, and is composed of an approximately square block, having a groove planed around its four sides, as shown in the partial section at the right. Into this groove are fitted four pieces which are pivoted at one end and at the other can be adjusted by the screws shown; the larger screw raising the piece, and the smaller screw having the opposite tendency, so that by their combined action the piece is readily adjusted and firmly held.

Starting with the square set as accurately as possible, two of these pieces, adjacent to each other, were adjusted to fit the square, and the block was then adjusted around to the place of beginning, where the error of the square was shown magnified in a way familiar to all mechanics who have ever tried to make a block really square on four sides. This error was then divided and adjusted as nearly as possible, and the process repeated until the square would go all around the block without showing the least variation. It was then assumed that both testing block and square were really square, as, in fact, they were.

This square is not yet manufactured for the market, but has been patented by its inventor, who, as a result of his experience with it, calls it a "precision" square. A specimen square we have had the privilege of examining, is certainly an admirable tool, whether considered as a piece of fine tool-making or in respect to its action in use.

In Casting a Big Kettle, Compressed Air Saves the Core.

The Riverside Iron Co., Kansas City, Mo., have been casting some large kettles for the Consolidated Smelting and Refining Co. The kettles are used for melting lead. One recently cast was 11 feet 5 inches in diameter and weighed 18,000 pounds. The bottom of the kettle was concave on the outside, that shape being best both for fuel economy and as reducing the liability to crack. The kettle was 2 feet 6 inches deep in the center, and 3 feet deep at the sides. It would hold 140,000 pounds of melted lead.

When the core was lowered in place, previous to pouring, it was found that a little trifling alteration was necessary, and when it had been raised again about 8 inches the chain broke. As the core weighed 14,000 pounds, it is easy to understand what should have happened, but, to the astonishment of everyone, the core was uninjured. The air in the mold let the core down so gently that no shock was perceptible. The kettle was finally cast successfully.

Bicycle Tools—XIII.

The J. W. Bryant Company, of La Porte, Ind., make bicycle wheel rims of manilla paper.

Mr. Bryant's conception of the paper rim idea resulted from his eighteen years' experience in papier maché manufactures in the line of photographic studio accessories, decoy ducks, and some other articles in which strength, lightness, durability and low cost are prime requisites. When the wood cycle wheel rim came into favor, Mr. Bryant, well knowing the suitability of paper for the purpose, began a series of elaborate experiments, which led to the production of paper rims, at once lighter and less liable to split than single-piece wood rims. The single-piece wood rim has, in some cases, an initial tension of its outer portions so nearly approaching the ultimate cohesive strength of the material as to cause it to split upon the slightest reduction of the stock. This initial tension of the outer portions of the single-piece wood rim is the inevitable result of bending the thick strip to a complete circle. No matter how perfectly soft the strip may be when it leaves the steam box, it begins cooling and drying on its outer surface as soon as the open air touches it, and hence this initial tension must always be present in every single-piece rim. In the built-up or laminated rim this tension is not evidenced by fracture; in the single-piece rim very frequent splitting in the course of manufacture shows that this initial tension not only exists, but is often great enough to cause a rim to split in the rim-turning lathe, and after successfully enduring the removal of a large cross-section area in the lathe, the rim is still liable to split in the sander's hands, from the removal of a thin shaving by use of the hand scraper in finishing the rim, although this scraper shaving may not be, and commonly is not more than about one five hundredth of an inch thick; and the hands who scrape and sand the rims are sometimes quite seriously wounded in the hand or fore-arm by a thrust of the large, sharp-pointed sliver formed by the splitting of a rim in process of smoothing.

The paper rim has no initial tension, and it has no grain, and cannot be split; it is subject to cross fracture only, and will endure a very heavy blow without failure, both before and after "stringing," or having its spokes and hub assembled with the rim to make the complete wheel. I was greatly surprised to see Mr. Bryant hold a paper rim, with its radial plane vertical, high above his head, and dash it down on a wooden floor with all the violence he could give, without the slightest injury to the rim. Mr. Bryant told me the same violent impact would be sustained by a paper rim carrying its spokes and hub, without injury.

Unquestionably the paper rim is extremely strong for its weight, and is also the most uniform in strength of the non-metallic rims. The single-piece rim is exactly what it was when it grew in the tree, and hence may be wholly strong or wholly weak; the laminated rim is made of several thin strips of wood, and hence, in case these strips did not originally form adjacent portions of the same plank, each laminated rim might be reasonably expected to come nearer a uniform medium strength than a single-piece rim; the paper rim, wound as it is from a continuous strip of the best manilla paper, perhaps the two hundredth of an inch in thickness, carries the idea of lamination well toward the limit, and in case the waterproof cement, with which the paper is coated as it runs off the reel on to the forming mould, is of a uniform strength, the paper rims cannot possibly vary much in their powers of resistance to shock. All cycle-wheel rims are loaded far within their safe limit for regular work; it is in case of shock only that failure occurs, and the paper rim, with its inherent evenness of strength, which offers no weak point to invite the beginning of fracture, is, therefore, in view of its absolute uniform structure, extremely well calculated to serve its purpose.

The Bryant Company are selling a few rims, but are principally engaged at present in greatly improving and increasing their factory, which will enter the season of 1897 with an output capacity of 2,000 rims per day. The machinery employed consists of winding machines, for winding and cementing the paper rim blanks, turning lathes and sanders; the winding machines and sanders are from Bryant Factory designs; the lathes are of the latest Rudolphe & Krummel pattern, of which a minute description is given in this paper. At the time of my visit, during the holiday week, the factory was being generally overhauled and re-arranged, and no photographs could be taken to give correct ideas of the manufacture of the paper rim; the processes are of interest, and will be given in full as soon as the plant is in condition to show.

The Rudolphe & Krummel rim-turning lathe, in its latest form, is an extremely creditable production, and fills some very trying requirements in the most satisfactory manner. Only one of these lathes is now at work; it is in New London, Conn. The one shown here is the second one built, not yet shipped. In addition to the automatic chuck-action requirement, the ideal rim-turning lathe must be so arranged as to enable every detail of its rim-turning movements to be performed not only with unfailing uniformity, but in the very shortest possible space of time.

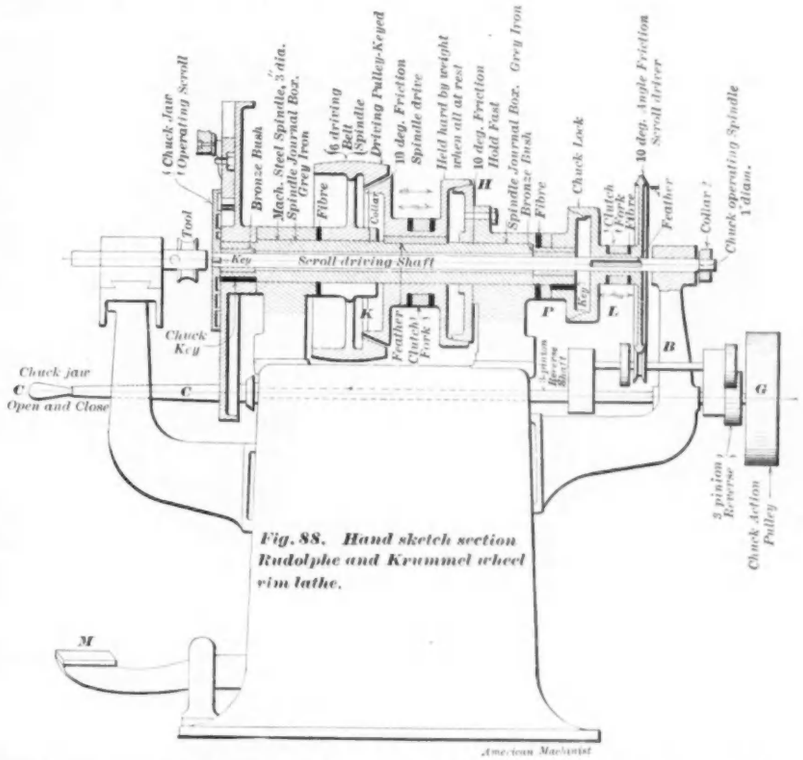


Fig. 88. Hand sketch section Rudolphe and Krummel wheel rim lathe.

The ideal operations of the rim-turning lathe are as follows: (1) Standing empty and idle, the spindle must be held rigidly from turning, with the chuck jaws in position to take a rim. (2) When a rim is placed in or on the chuck jaws, the jaws must at once close or open automatically to grasp the rim, and this grasping must be very delicately adjusted, as to force or tightness of closure; if the chuck is too powerful, the frail wood rim will be either pulled apart or crushed; if not chucked tightly enough, the rim will slip in turning with the full form cutters employed—these chucking conditions are difficult to meet with automatic devices.

(3) As soon as the rim is chucked, the chuck must be locked, and the spindle must be released, and the spindle must be put in motion as quickly as possible; as soon as the spindle is in motion, the turning must begin, and, as the turning cut is hand-fed, the hands of the operator must be on the tool-feed screw wheel the very instant the spindle starts, or there will be a loss of time at this point. As soon as the tool slide is run up to the stop, it must go back again to its original rim-receiving position, and at the same time the chuck jaws must release the finished rim, so that it will be easily grasped and removed by the hand of the workman.

It is evident at the outset that to fill these conditions there can be but one hand lever and one treadle used, as the operator must have one foot free to stand on, and must have one hand free to manage the tool slide-feed screw wheel, or else lose time in manipulation.

The engravings given are a hand sketch section, Fig. 88; a front elevation, Fig. 89; a side elevation, Fig. 90, and a rear elevation, Fig. 91. The same letters refer to the same parts throughout. Referring to Fig. 88, left-hand end, the first thing is the scroll for operating the chuck jaws; this is 1¾-inch pitch, with 1⅛-inch groove and ⅝-inch land, and the chuck-jaw friction rolls are 1⅛-inch diameter. The spindle is 3-inch diameter steel, with a hole 1⅛ inches through its entire length, and having bronze bushes forced into each end. This main spindle runs in plain gray-iron bearings fitted with "solid oil" cups. Journaled in the bronze bushes in the spindle bore, is the scroll driving shaft or chuck-operating spindle —it has both names in Fig. 88, which has the chuck-jaw operating scroll keyed to its front end. It is obvious that if the spindle is held and the scroll is turned by its driving shaft, the chuck jaws will be moved; but if the spindle and the scroll shaft are locked together, then the chuck jaws cannot be moved. Keyed to the right end of the spindle is the male part of the chuck-locking friction clutch. All of the friction clutches are of gray iron, 10-degree angles, third trial—the first trial being 15-degree, which did not hold, and the second being 8-degree, which did not let go; 10-degree works perfectly well. The female part of the chuck lock is formed in one piece of gray iron, with the large, 10-degree friction driver, which slides on a feather on the scroll driving shaft and turns with it. This large friction scroll driver *A* gears with either one of two grooved friction pinions *B*, one of which is thrown in when the hand lever *C* is pulled up, and the other when *C* is pushed down. The friction pinions *B* are driven in contrary directions by the common gear and 3-pinion reverse action often used in engine lathe feeds. The friction pinions *B* are mounted on the long rockshaft *D*, in two two-journaled rocker arms *E*, keyed to *D*; the rockshaft *D* is operated through the bevel pinions *F*, and hand lever *C* mounted on a shaft at right-angles to *D*, because *C* would be in the way if it were made long enough to operate *D* easily, and at the same time were keyed directly on *D*. The friction pinions *B* are driven from a gear carried on the hub of the scroll driving pulley *G*, which is driven independently by its own belt from the countershaft. By this scroll driving rig, the chuck jaws can be made to open or close, according as the hand lever *C* is moved up or down; and the force with which the jaws are driven depends on the pressure on *C*, which holds either friction pinion against the scroll shaft driver *A*. This is a very simple and well-contrived automatic chuck-opening and closing rig, and is one I have not seen before, and it was also new to Mr. Krummel, who designed it. It works with ease, and is certain in action, and can only give a definite chuck-jaw effect on the work grasped. The rim lathes previously described have had nothing in place of this feature, which is very speedy and very easy on the workman.

Beginning at the left end of the main spindle, the first piece is the chuck-jaw disk, keyed to the spindle nose; next comes the headstock spindle journal, then a vulcanised fiber washer, and then the 6¼-inch face, spindle-driving pulley, loose on the spindle; the right side of this pulley forms the female part of a 10-degree friction clutch sliding on a feather in the spindle, and necked down to take a clutch fork, and then, to the right of the fork neck, enlarged again to form the female part of another 10-degree friction clutch, which can engage with a stationary holdfast male clutch part *H*, bolted to an uprising lug on the right-hand headstock spindle journal. Obviously, if the splined, double-clutch-ended piece *K* is moved to the right, it will lock the spindle fast to the headstock; and if *K* is moved to the left, it will release the spindle from the headstock and leave it free to turn; and if this movement of *K* to the left is sufficiently continued, then *K* will engage with the female chuck face in the spindle-driving pulley, and so cause the spindle to partake of the pulley motion. The forks which operate *K* and *L* are both moved to the left by the treadle *M*, and to the right by the weight *N*; both *M* and *N* act through chains carried over "f" rollers, and a coiled spring "evener" is introduced at *O*, in the fork lever which operates *L*, so as to hold *L* locked to the spindle by the pressure of *O*, while the treadle action is continued to make an effective friction drive between the main driving pulley and *K*. The effect of this spindle-driving and spindle-holding rig is as follows: With everything free, the weight *N* pulls the treadle *M* up and moves *K* and *L* to the right until *K* engages with *H*, and thus locks the spindle to the headstock, and leaves *L* free to turn. If the foot is placed on the treadle, the first thing done is to release *K* from *H*; this leaves the spindle free to turn. Next *L* engages *P*; this locks the chuck and spindle together. Then *K* engages the spindle-driving pulley, and the spindle and chuck continue to run as long as sufficient treadle pressure and driving-belt effect are present. This spindle-holding,

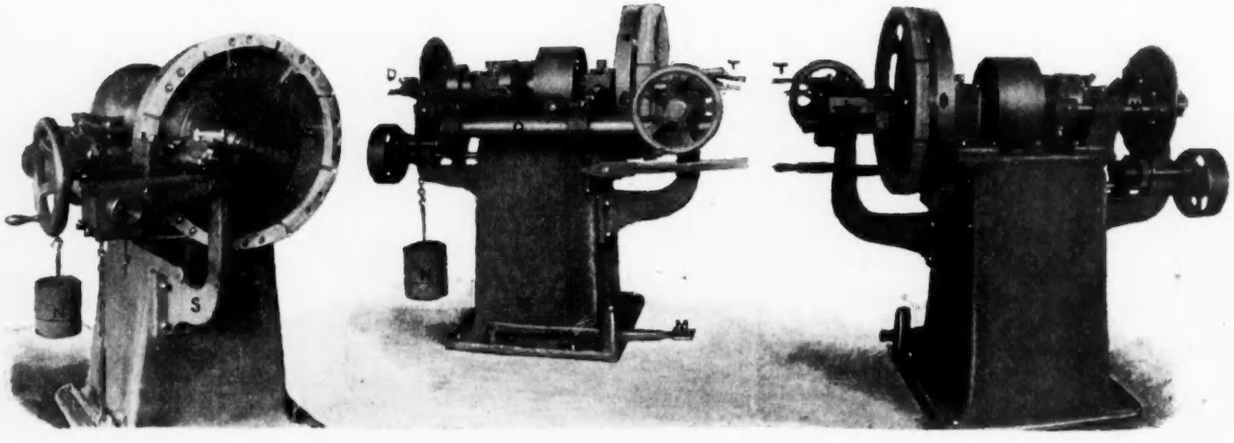


Fig. 89. Fig. 90. Fig. 91.

RIM-TURNING LATHE.

releasing and driving is also admirable, and Rudolphe & Krummel may well be proud of this lathe. It is a very fine piece of designing, and a wonderfully effective tool.

The tool slide *R* is supported on the heavy round bar *Q*, which carries the hand-screw-fed tool post, dovetailed to its upper face, and *R* is also supported at its inner end by the bracket *S*, bolted to the hollow pillar base of the machine. The hand wheel on the tool-post feed screw is very large, and is provided with a handle for quick action. The cutting tools are "form" tools, having the profile of the rim section (at the clearance angle) for their working face; these tools are dovetailed on the back, and held on a round stock, which slides in a horizontal plane parallel to the spindle axis, to let the rims in and out of the chuck when working the inside cut; this horizontal traverse of the tool holder is effected by a small bell-crank lever and link at *T*. The dovetail on the back of the tools is grasped by washers and a through bolt through the cylindrical tool holder, in the shaper cutter-head style; this dovetail on the back of the "form" tools avoids the shank at right angles to the body of the form tool, which is commonly used for holding such tools, and greatly reduces cost and prolongs the tool life.

The two clutch forks which operate the spindle and chuck clutches are fulcrumed on the horrizontal bar *U*, supported in a cylindrical seat in a lug cast solid on the headstock.

This Rudolphe & Krummel wheel-rim lathe can make the outside cuts on 1,000 rims, or the inside cuts on 750 rims, per day of ten hours. The inside cut has a much greater length of working traverse than the outside cut, and hence requires more time in making.

Some Data Relating to Forge-Shop Design.*

BY PAUL MELLEN CHAMBERLAIN,
Agricultural College, Mich.

During the winter of 1893-94 a new forge shop was erected for the mechanical department of the Michigan Agricultural College. Some features of its arrangement and data regarding air blast and suction for smoke expulsion may prove of interest. The floor of the shop is 30 feet by 40 feet, and is set with twenty forges in pairs as per plan view, Fig. 2. A general view is reproduced from a photograph in Fig. 1. The forges were not designed for the arrangement, but ten of them being on hand they were used, and the hoods and duplicate forges were for the most part made by the students. The hoods and smoke-flues could not be suspended from above in the usual manner without cluttering up the room and obstructing the instructor's view. The smoke hoods and pipes were consequently arranged as shown in elevation in Fig. 3—a scheme which was thought by the writer at that time to be entirely new. The blower and exhaust fan were placed on a platform, as shown, to save floor space, and for like reason a bracket engine was used. Correspondence with builders of fans elicited such conflicting advice as to capacities necessary, that some crude experiments were undertaken, which resulted in deciding on using a blower with an outlet six inches in diameter which had been used in the old shop, a present from the B. F. Sturtevant Company to the college some years ago, and an exhaust fan having an inlet fifteen inches in diameter, purchased from the Boston Blower Company. The blower has since been removed to supply the cupola, and replaced with a nameless blower having an outlet of five inches. The hoods are made of cast iron and fitted with gates. Different heights for hood above the fire were tried up to twelve inches, showing little decrease of efficiency, but were finally located about six inches above the top of the forge, being sufficiently out of the way of the fire and affording a better view in the room. The smoke-flue leading from each pair of hoods is made of galvanized iron, number twenty gauge, and is five inches in diameter, gradually enlarging towards the main pipe to give equal draughts to the different hoods. The blast-pipe is also made of galvanized iron, number twenty-two gauge, and reduces to a diameter of two inches, where it meets the tee leading to the two forges. The tuyeres caps are common two-inch caps drilled with twenty-five quarter-inch holes countersunk conically from the under side. The smoke and blast pipes are carried under ground in a box trench made of two-inch oak tarred on the outside, and made with removable covers. (Figs. 3 and 4.) Two years of use have not developed signs of necessity of their removal for repairs or cleaning. The original design contemplated carrying the smoke-flue beyond the exhaust fan around the ceiling of the room, for heating.

The blower is at present speeded up be-

Fig. 1—VIEW OF FORGE SHOP.

*Presented at the New York meeting (December, 1895) of the American Society of Mechanical Engineers.

yond what is required, and to have the gates in the blast-pipes wide open during the test, the inlet of the blower was sufficiently closed to allow only the necessary pressure in the pipe. The revolutions stated in the table were determined in a separate run when the blower was open, and speeded down to give the pressures indicated in the table. The run reported herewith was of two hours' duration, and readings taken every fifteen minutes of the temperatures, revolutions and pressures.

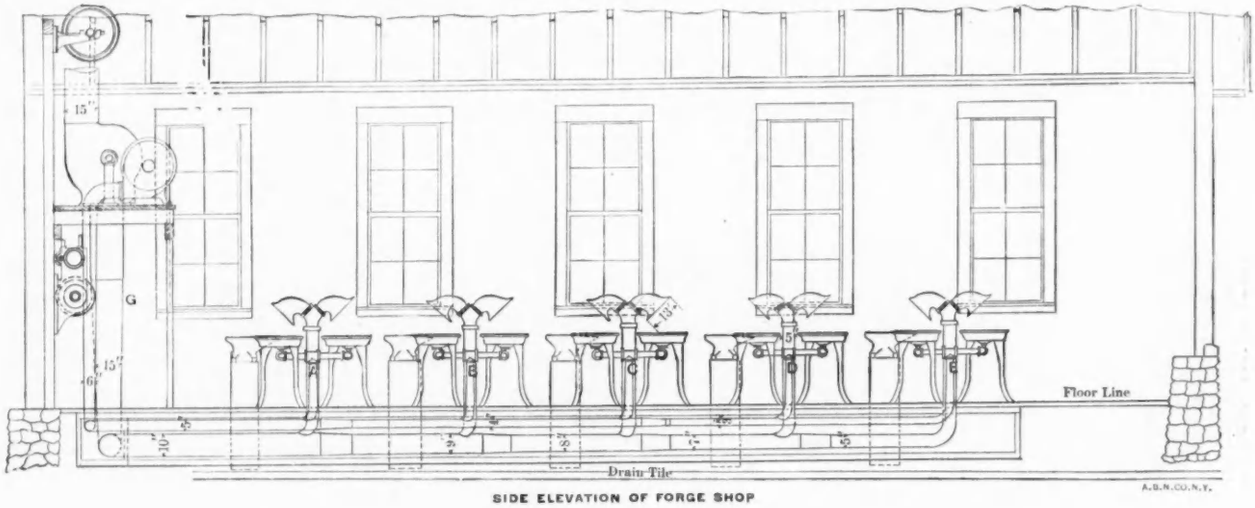
ance in taking readings. The blast was very much less in pressure in the pipes than is the usual practice, but was all the fires would stand with the gates wide open. The fires undoubtedly consumed more coal than they would in ordinary use, but the consumption of coal seems to the writer to be the only basis for comparison.

Taking the averages of revolutions, pressures and temperatures, as shown in table below, we can calculate the cubic feet of air and gas handled.

In the case of the exhaust:

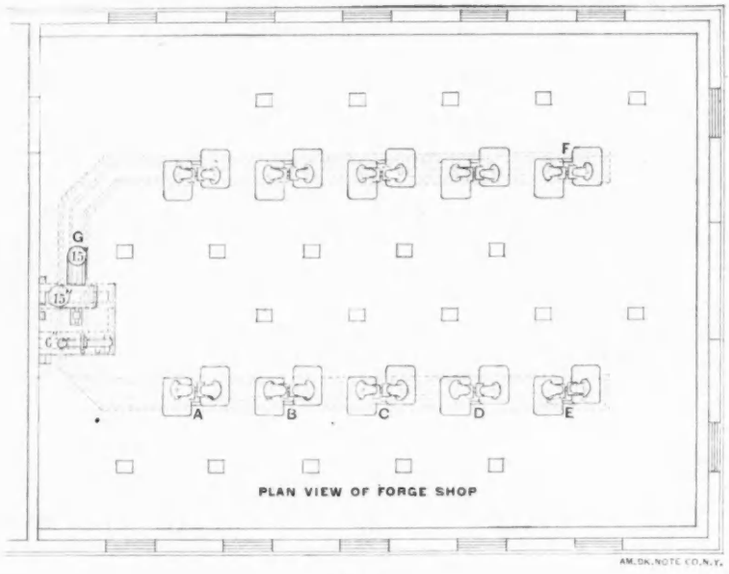
Where t = 252 degrees,
p = 29.92 inches,
h = .6 inch,
V = 59.8 feet per second.

In neither case is the co-efficient for contraction or friction taken into account; this may vary in value from 90 to 99 per cent. in the case of the blower, and probably not far different in the case of the exhaust.



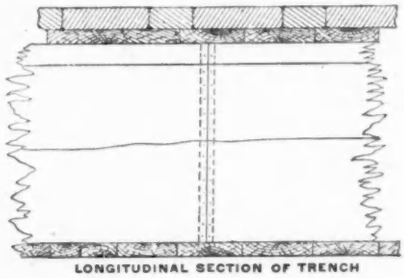
SIDE ELEVATION OF FORGE SHOP

Fig. 2.



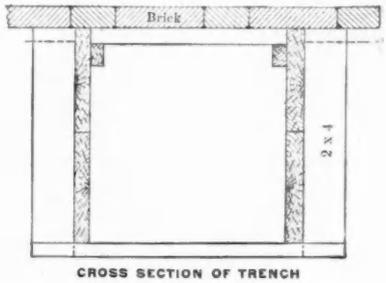
PLAN VIEW OF FORGE SHOP

Fig. 3.



LONGITUDINAL SECTION OF TRENCH

Fig. 4.



CROSS SECTION OF TRENCH

Fig. 5.

Readings were taken only on six sets of forges, as presumably representing a fair average selected in the positions indicated on Fig. 2 by A, B ,C, D, E, F. The fires were first put in prime condition by a practical smith, who was instructed to obtain the requisite blast for a good forging fire, as large as would be practicable with the size of tuyere and forge, and maintain the fire throughout the run, keeping account of the weight of coal used during the run. The fires were about eighteen inches in diameter. The writer has Mr. A. L. Westcott to thank for assist-

Where V = velocity in feet per second,
t = temperature,
h = height of water in inches in draught gauge, and
p = barometric pressure in inches of mercury.

$$V = 352 \sqrt{\left(1+.00203\,(t-32)\right) \times \frac{h}{p}}.$$

In the case of the blast:

Where t = 131.66 degrees,
p = 29.92 inches,
h = .7 inch,
V = 59 feet per second.

The combined area of the twenty tuyeres of twenty-five ¼-inch holes each = .17 square foot.

The combined area of the ten 5-inch smoke-pipes = 1.36 square feet.

Cubic feet of air handled for the blast = 59 × .17 = 10.03 cubic feet per second.

Cubic feet of smoke and gases handled by the exhaust fan = 59.8 × 1.36 = 81.33 cubic feet per second.

	Revolutions.		Draft in Inches of Water.						Blast in Inches of Water.						Temperatures Fahrenheit.							
			Blast-pipe at						Smoke-pipe at						Blast-pipe at						Inlet to Blower.	Smoke Flue at
	Blower.	Exhaust Fan.	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F		G
1	1,000	900	5/8	1/2	1/2	3/8	1/2	1/2	7/8	1/2	1/2	3/8	1/2	3/4	98	98	99	100	101	98	68	173
2	1,200	900	3/4	5/8	5/8	1/2	3/8	5/8	1	1/2	1/2	1/2	5/8	3/4	104	108	110	112	113	114	73	218
3	1,400	1,050	7/8	3/4	3/4	5/8	3/4	3/4	7/8	3/4	3/4	5/8	5/8	5/8	110	122	132	140	144	145	83	275
4	1,200	1,000	3/4	5/8	5/8	1/2	5/8	5/8	1	3/4	3/4	1/2	5/8	3/4	116	120	126	132	134	148	83	260
5	1,400	1,070	7/8	1/2	1/2	1/2	5/8	5/8	3/4	1/2	1/2	3/8	1/2	1/2	128	136	142	150	156	152	80	291
6	1,500	1,000	1	3/4	3/4	3/4	3/4	5/8	7/8	3/4	1/2	3/8	3/8	1/2	128	138	146	152	156	148	83	265
7	1,400	1,000	7/8	3/4	3/4	5/8	3/4	5/8	3/4	5/8	3/8	3/8	3/8	5/8	132	142	150	153	159	160	84	264
8	1,600	1,030	1 1/8	1	1 3/8	1	7/8	3/4	3/4	1/2	1/2	1/4	1/4	3/8	130	140	148	154	150	152	84	270
Average	1,337	994	.85	.69	.85	.58	.62	.64	.85	.64	.55	.45	.51	.58	118	125	132	137	139	139	80	252
			.7						.6						131.66							

Run of two hours. Readings taken every fifteen minutes. Two hundred and sixty pounds of coal consumed

The ratio of air for blast to exhaust is thus about 1 to 8 by volume.

Taking the weight of air at 250 degrees, compared with air at 62 degrees, as $\frac{1}{1.35}$, the fan would have handled 4.55 pounds per second.

Taking the weight of air at 140 degrees, compared with air at 62 degrees, as $\frac{1}{1.149}$, the blower would have handled .66 pound per second. For the two hours run, 7,200 seconds.

The blower, according to the above assumptions, would have handled 72,216 cubic feet, or 4,492 pounds of air.

The exhaust fan would have handled 585,576 cubic feet, or 32,733 pounds of air.

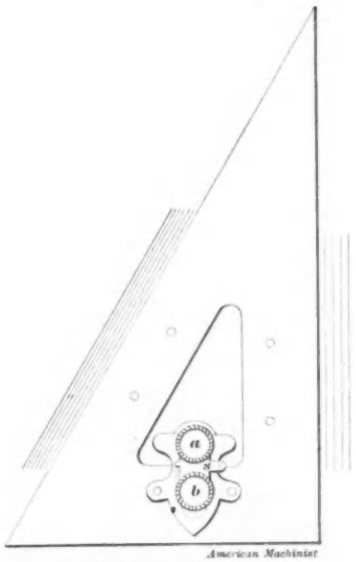
For each pound of coal consumed, 277 cubic feet at 140 degrees, or 17 pounds of air were supplied; and 2,252 cubic feet at 250 degrees, or 126 pounds exhausted.

Taking the theoretical calorific value of the coal at 12,000 heat units per pound, and the specific heat of the exhaust gases, smoke and air at .24, which is approximately correct, adding 75 per cent. of the weight of fuel to the air handled, making a total of 32,928 pounds, we would detect 1,950,000 heat units as compared with the 3,120,000 heat units of the coal of the remainder; a portion was given up to the blast, $4,492 \times (132 - 80) \times .237 = 55,359$. Some of this wasted heat could doubtless be utilized by drawing the supply to the blower through the trench carrying the exhaust pipes.

It is interesting to note that of all the theoretical calorific value of the coal we can account for about 60 per cent. of it in the smokestack and blast-pipe, about 1.7 per cent. of the total being given back to the fire through the blast-pipe.

A still greater amount could be thus utilized by warming the supply to the blower by passage over the exhaust flues.

Mr. B. H. Warren, who for the past year or more has been connected with the Pratt & Whitney Co., Hartford, Conn., has accepted a position with the Westinghouse Electric Co., and will probably be stationed at Pittsburgh, Pa.



A Simple Section Liner.

We illustrate herewith a section-lining device which is adapted to be readily attached to any T-square or triangle, by simply drilling two small holes, as indicated, a template for that purpose accompanying the device.

We show it applied to a 30-degree triangle, in which the holes for attaching it to either of the two other sides are shown. The screw *a* has a movement to the right or left, the amount of which movement is governed by a triangular opening in the slide *s*, which is graduated as shown, and can be adjusted and clamped by the screw *b*.

The screw *a* is tapped into a plate at the bottom, which rests upon the paper and is roughed sufficiently to make it retain its place when pressed down. With the first and second fingers placed in the concaved heads of the screws *a* and *b*, a species of walking movement gives a uniform spacing.

The device is very simple, and very easily applied and used. It is made of brass, nickeled, by the Dayton Machinery & Tool Works, Dayton, O.

The year 1895 was not generally considered as very favorable for new enterprises, and yet it was one of the most active in textile mill construction that the country has ever seen. The year 1892 has, in the retrospect, been regarded as memorable and prosperous; yet in 1895 there were 357 new mill enterprises, or one more than in 1892. The net gain of 1895 over 1894 was 94 mill plants. There were 146 new cotton mills, 99 knitting mills, 61 woolen mills, 23 silk mills, and 28 miscellaneous. These were distributed as follows: North Carolina, 63; Pennsylvania, 46; New York, 39; Massachusetts, 34; Georgia, 28; South Carolina, 32; Rhode Island, 12; Alabama, 12. The remainder are scattered over seventeen States.

Sub-Presses.

BY A. H. CLEAVES.

A sub-press is an undersized or small press used in conjunction with a large punch press for certain classes of die work.

Such a sub-press is illustrated in Figs. 1 and 2, and is used quite extensively in watch factories and shops where small punch and die work of an accurate character is in demand.

They are manufactured and kept in stock in one or two sizes by the American Watch Tool Co., Waltham, Mass., and probably, also, by other firms in the same line of business.

They furnish the advantages of convenience and accuracy in making small dies, as well as the benefit of having the punch and die always in position for work; so that it has only to be adjusted for cutting depth, which is done on the large press.

The Stiles & Parker press is especially adapted for using sub-presses; and watch manufacturers usually insist on getting such a press with worm adjustment, which is much preferable to a pinion and segment one.

In Fig. 1, *A* is the top or body of the sub-press, and *B* the base; *D*, the cap; *E*, a ring for holding the babbitt metal in place, being threaded on to *A*; *F* and *G* are punch and die blanks; *HH*, screws for securing top to base; and *I*, one of

a pair of clamps for securing the sub-press to bed of large press by notches milled across ends of sub-press base, as shown.

In Fig. 1, *C* is the plunger and *J* is a lining of babbitt, or similar composition, which furnishes the bearing for the former. The grooves shown more fully in the end view—four in the plunger, and four in the body of sub-press—are to keep the plunger from turning in the latter.

From twenty to a hundred presses are fitted up in a lot, when *A* is bored out tapering to receive the babbitt. First, however, *A* is chucked and faced off on the large end, and the boring at *L* made to some standard. A jig fits this boring for drilling and tapping holes for *HH*.

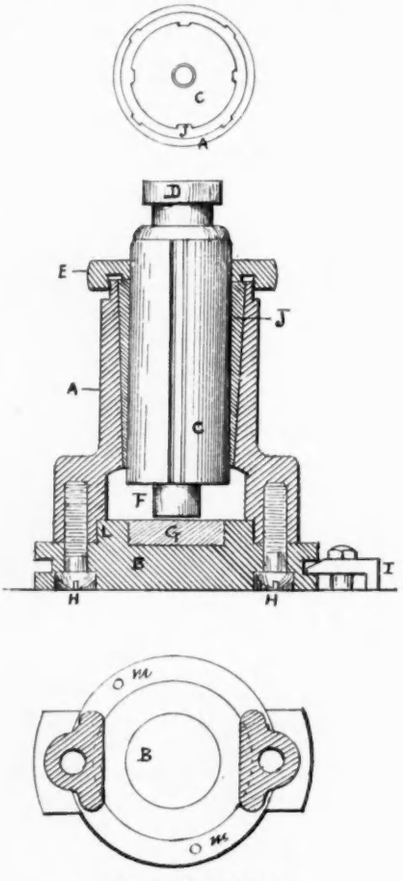


Fig. 1—SUB-PRESS.

The same boring fits a projection on a face-plate, to which it is screwed with *HH*. Then, with a taper attachment, the tapering babbitt chamber is bored out. It is then held in any convenient way upon an angle iron on a shaper; the face of the iron inclined enough to allow the shaper tool to conform to taper bore in sub-press. The work is moved round to allow of making the four grooves, which are better for not being equally divided, so the plunger, when taken out of press, can be put back in same position without mistake.

In planing the plunger grooves, the plunger must be held in a special holder perfectly true, so that the grooves will be parallel with center line of same; otherwise the plunger would not run in the babbitt.

Any device that will center the plunger with the borings *L* and taper in *A* can be used for pouring in the metal by.

The centers in *C* are used finally for fitting *A* to *B* at *L*; this after the babbitting is done.

A cheaper plan for babbitting is to cast *A* with chamber closed at the ends, which are bored to fit plunger *C*. Then *C* only is grooved, and several holes are bored in the shell *A* to keep babbitt from moving and to be used for pouring the metal in. The grooves are plugged or closed in any way to prevent the escape of the babbitt.

In this plan, an expansive composition is used which expands in cooling, viz.: Lead, 102 ounces; antimony, 28 ounces; bismuth, 14 ounces. Melt the lead, then

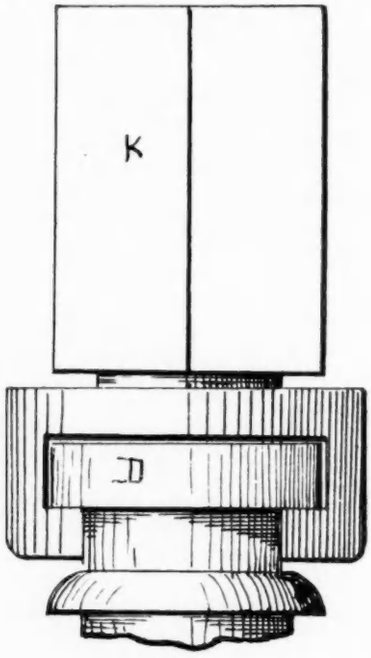


Fig. 2.

put in the antimony, afterwards the bismuth.

Fig. 2 shows a receiver for the plunger cap, that is held in the large press; which may be either turned out and opened in the shaper, or milled out as shown at *K*.

If it is desirable at any time to set a punch and die that may have sprung in tempering, it is easily done by opening the joint at *L*, or making it loose; as well, also, the screw clearance for *HH*. Then locate the punch and die and put in dowel pins at *MM*.

The plungers are held on a base made for the purpose, and run in the large press, continuously, until they work freely. Then, if necessary, or if found loose at any time after usage, the taper babbitt can be forced down under the large press and held with ring *E*.

It will be seen that the plungers *C* must be of uniform diameter the whole length, and smooth; and they are generally ground in a parallel grinder and smoothed, lengthwise, with emery-cloth. To babbitt well, the casting and plunger must be hot. Being ground to standard size, a ring or collar can be used for back-resting; or the grooves can be turned out for a short distance on the end, and the turned surface used.

Chicago, Ill.

On the Cultivation of the Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

I feel it incumbent upon me to apologize to the many friends I have been so fortunate as to make among the readers of "American Machinist," for my apparent neglect of some solutions forwarded in response to problems No. 6 and 7, published in the issue of May 3, 1894. The editor of this journal has been cognizant of the circumstances that have compelled me to postpone my attention to them, and he exonerates me from any intentional discourtesy to those who took the trouble to forward the solutions that have not yet appeared. As these circumstances relate entirely to sickness in my family which interfered with my time so much that only my private and personal affairs could receive my attention, I trust no other explanation or apology will be needed.

I shall endeavor to present in this article all the remaining solutions of problem No. 7, of sufficient merit to warrant such notice; but as considerable time has elapsed since the problems were given out it will save time and trouble, particularly to new subscribers, to restate it.

Problem No. 7.—It was required that a ratchet wheel actuated by pawl mechanism and by a rock-lever rocking on the same shaft or spindle, should be caused by suitable additional mechanism to move when the rock-lever is moved in either direction, the wheel, however, to rotate always in the same direction, and through the same number of degrees of arc for each movement of the rock-lever.

This general statement, in connection with the solutions presented, will, I think, suffice for the comprehension of the problem by those who did not see it when first announced.

I will present the remaining solutions as briefly as I can, reserving solutions of No. 6 for another article.

Figs. 1 and 2 are respectively a sectional plan and side elevation of a solution to problem No. 7, by Mr. Frank Scoville, of Oakland, Cal. In this movement, the ratchet wheel *A*, and gear *R*, are fastened together and run loosely on the shaft *C*. The shaft *K* carrying pinions *P* and *S*, is journaled in the lever *B*. The gear *E* is loose on *C* and has a pawl *N*,

journaled to it by a stud-pin *n*. The ratchet *L* is fast on *C*, and the pawl *N* engages with it. The gear *R* meshes with *P*, and the gear *E* meshes with *S*. The speed ratio of *P* to *R* is 3:1, and that of *S* to *E* is 6:1. If *E* be turned once around, *R* will turn twice around in the same direction; but, if *E* is held by the ratchet *L*, and *B* is moved a full turn in a direction opposite to that indicated by the arrow, it will cause *R* to move a full turn in the opposite direction. These movements will be respectively through the same arcs whether the arcs be 10 degrees or 360 degrees, or any intermediate number of degrees. The smaller limit will be that corresponding with a single tooth of the ratchet *A*. The arrangement of the pawl *M* and the rock-lever *B* is the same as that given in the problem.

Mr. Scoville's solution may, perhaps, be considered as a round-about way of obtaining the desired result; but it has the advantage that the amplitude of motion of the rock-lever is not limited to any arc less than 360 degrees, and in some cases this might be an important feature in such a movement. I have had, recently, to deal with a device in which such a ratchet and pawl lever is required to oscillate through an arc of 324 degrees.

Figs. 3 and 4 are respectively an elevation and plan of a solution to problem No. 7, contributed by Mr. James P. Hayes, of Meriden, Conn. The general principle of the movement is similar to that in Mr. Scoville's solution, but the details are different.

In the figures, *A* is the ratchet wheel;

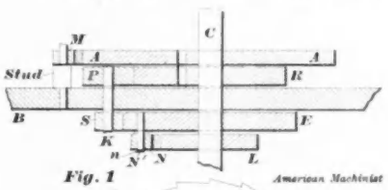


Fig. 1

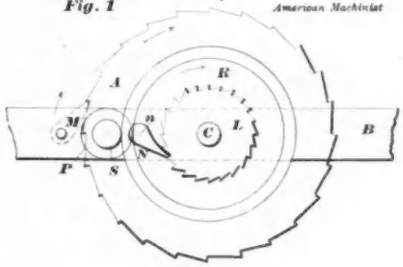


Fig. 2

B, the rock-lever, and *c*, the shaft. *E* is a gear having half the number of teeth that the gear *D* has. The gear *F* is revolved by the gear *E*, when the rock-lever *B* is moved in either direction. *G* is a gear having the same number of teeth that *F* has. *G* revolves freely upon the shaft *c*. Attached to *G* is an arm *H*, which carries the pawl *I*. On the short end of the lever *B* is another pawl *J*. Both pawls work in the ratchet *A*, which revolves in the direction of the arrow.

Mr. Hayes also appended a pencil sketch of another solution, involving the use of a flexible steel band as a substitute for gears. I do not find the explanation of this movement quite clear enough for use in this article. He says he finds "these problems quite profitable to think about while the lathe is taking a cut," and con-

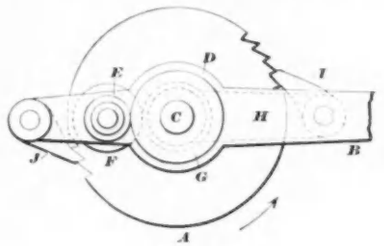


Fig. 3

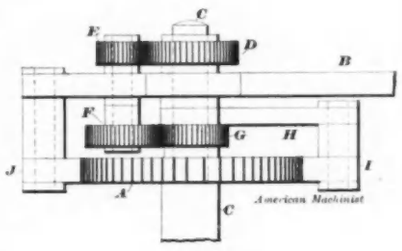


Fig. 4

siders it "good practice to put an idea on paper after having thought it out."

In Figs. 5 and 6 is shown a solution contributed by R. S. Wallace, of Chicago, Ill., who gives the following description of the movement:

"The disc *a* is to rotate continuously, say, in the direction of the arrow, when the lever *c* is moved alternately in opposite directions, and the angle through which *a* rotates is to be equal for equal movements of *c* in either direction. To accomplish this, we have fastened to the face of disc *a*, a spur gear *e*, which will rotate with *a* on shaft *b*, which supports the whole mechanism; also on shaft *b* we place another spur gear *f*, of somewhat less diameter, to which the lever *c* is attached. This gear is free to rotate on shaft *b*, and transmits motion to *a* only when moved in the direction of the arrow—this by means of a circular ratchet cut in the face of gear *e*, and a spring click *j*, in *f*. By means of two arms, *d* and d^1, secured to shaft *b*, we support spindle *n*, on which are two gears *g* (equal in diameter to *e* and engaging with *e*), and *h*, which is of same diameter as *f*, but engages with it through the pinion *i*, which is also supported by arm *d*. The gears *g* and *h* are free to rotate on *n*, and are independent of each other for motion in opposite directions, but connected by a ratchet and click *k*, similar to the click *j*, in *f*.

"Thus we see that any upward movement of the lever *c* by means of the ratchet and click *j*, carries disc *a* in the direction of the arrow; while, by means of the gears, *h* rotates in the same direction as *f*, and *g* in the opposite direction to *h*, *f* and *e*. But when the motion of the lever *c* is downward, the click *j* does not move *a*, but through the pinion *i* it moves *h*, and by the click *k* causes *g* to rotate in the same direction, producing an opposite rotation in *e*, or rotation still in the direction of the arrow. The gear *f* being of equal diameter with *h* and *g* (equal to *e*), the disc *a* rotates through *h*, equal angles for equal angles of motion of the lever *c*, in opposite directions. If desired, *c* can be moved through more than one-half a revolution in either direction."

In Figs. 7 and 8 are shown respectively a plan and side elevation of a solution of Problem No. 7, contributed by Mr. W. P. Tarbell, Milford, N. H. Mr. Tarbell prefaces his description with the remark that it seems to him, "in a general problem like this one, that solution is best which meets the requirements with a simple and practical construction, and at the same time presents the greater number of additional features of advantage, thus fitting it for a wider range of usefulness as a mechanical movement. And he states that it was his endeavor to supply such a movement. The following is his description:

"In my drawings like parts are alike designated in both views, and to show construction clearly the relative position of *G* is changed. The teeth are not shown on the spur wheels. The ratchet wheel *A* and bar *B* are freely supported on the fixed shaft *C*. *D* is a gear wheel fastened to *C*. *M* and *L* are gears formed or fastened together, being freely supported on a stud projecting from *B*. Gears *D* and *L* have the same diameter and number of teeth and mesh together. *E* is a gear, loose on the shaft *C*, carrying

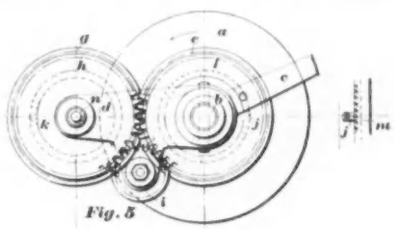


Fig. 5

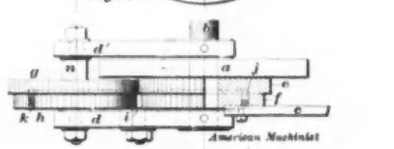


Fig. 6

an arm *G*, its outer end supporting the pawl *H*, which engages one side of the ratchet wheel *A*. The gear *M* has double the number of teeth of *E*, and is intended to drive it. The pawl *I* engages *A* and is suitably held to *B*. With the addition of springs to keep the pawls in position the mechanism is now complete.

"In operation, with *B* moving through one revolution, *G* will do the same, but in the opposite direction, for with one rotation of *B*, as indicated, it is seen that *L* in swinging completely around the fixed gear *D* itself, with *M*, makes one

axial revolution in the direction indicated; at the same time *M* has driven *E* and *G* through one revolution, in the opposite direction.

"Of course, the same relation of movements holds good for any number of revolutions of *B*, or fraction thereof, and thus any stroke or vibration of the bar *B* may be had, and without interference.

"By a suitable change of gears any desired rate of travel between *B* and *G* could be had, even to changing their directional ratio. To me this seems a satisfactory solution for an interesting problem."

This solution is well thought out and very clearly explained. The scope of the movement is very great, the minimum limit of motion is an arc comprising a single tooth of the ratchet, while there is really no maximum limit.

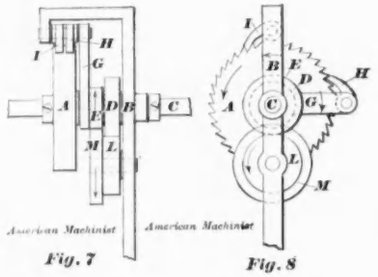


Fig. 7 *Fig. 8*

Mr. Joseph Becvar, of Cleveland, O., sends five solutions of problem No. 7, the first of which is identical with that contributed by Mr. D. B. Getty. Figs. 9 and 10 illustrate a modification of that movement, which is thus described. The rock-lever is shown at *a*, the spindle at *d*, and *k* is a double ear support for the two levers *n* and *m*, which levers carry the pawls *c* and c^1 pivoted on the screw pins *r* and r^1. Slots are cut in the disk at the end of the lever *a*, opposite each other, and at an angle which depends upon the required movement of the end of the lever *a*. It is evident that when the lever goes down the two pawls will go up, one pushing the wheel in the direction opposite to that in which the hands

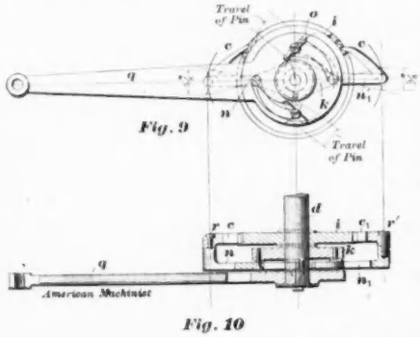


Fig. 9

Fig. 10

of a clock move while the other slides over the same number of teeth to repeat the movement of the ratchet wheel when the movement of the main lever is reversed. I cannot see that the complications of this movement give it any particular advantage over the movement shown by Mr. Getty above referred to, which is, therefore, to be preferred on the ground of its simplicity. Mr. Becvar's fourth and fifth solutions are subject to the same criticism, being merely modifications of the double pawl movement shown by Mr. Getty, and involving complications which, so far from improving that movement, are really inferior to it, as they can only work through quite limited arcs.

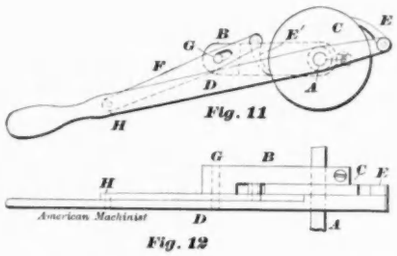


Fig. 11

Fig. 12

Figs. 11 and 12 illustrate a solution contributed by Mr. H. E. Hawes, of New York City. In this solution, *A* is the fixed or dead spindle, and *B* is an arm rigidly keyed to the spindle. The ratchet wheel *C* turns freely on the spindle. *D* is a rock-lever fulcrumed on *A*, and carrying at one end the pawl *E*. *F* is another rock-lever, fulcrumed on the pin *G* by means of a slot, which gives the rock-lever some longitudinal play. At the end of *F*, next the ratchet wheel, is pivoted the pawl E^1. Lastly, the end of *F*, opposite the pawl, is pivoted at *H* to the rock-lever *D*. The device will work in accordance with the conditions of the problem, if an idle, holding pawl be made to hold the ratchet from moving against lost motion of the pawls, and if a good deal of back-lash be allowed, and the rock-lever *D* be moved through a very limited arc. I do not regard the device as a good mechanical movement, and have presented it more as an illustration of "how not to do it," than for any other purpose.

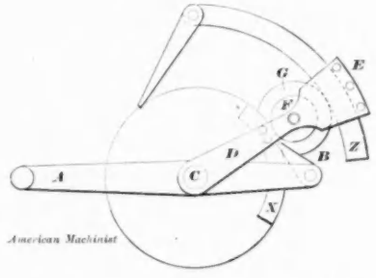


Fig. 13

The following is a letter from Mr. Walter Gribben, of Brooklyn, N. Y., who has furnished some very good solutions to this series of problems, and has made some good suggestions, as well as some valuable criticisms. Mr. Gribben writes:

"I have just been looking at my "American Machinist" for December 13, 1894, which I only had time to glance over hurriedly when I first received it, and it occurs to me that the solution of Problem No. 7 (offered by Mr. Fred R. Dawson, of Saxonville, Mass.—see Fig. 7, in issue named) would not operate according to the conditions of the problem. I think his two segmental racks, *X* and *Z*, would have equal linear movements, but not equal angular movements, as they are of different radii, yet both mesh with the same pinion *F*.

"The device could be made, however, to give equal angular movements to both pawls by substituting for Mr. Dawson's pinion *F*, two gears *F* and *G*, Fig. 13, these two gears being fastened together and rotating as one gear. The gears *F* and *G* should be in the same ratio as the respective pitch radii of the segmental racks *X* and *Z*.

"I also wish to call attention to timing the gears. Mr. Dawson shows his pinion *F* in mesh, with the racks near the top ends of each at the same time, while the meshing point of one rack should be the same angular distance from its top end that the meshing point of the other rack is from its bottom end at the same instant of time, otherwise the full length of the racks could not be utilized."

Mr. Gribben's communication will close the consideration of Problem No. 7. I will present in my next article some solutions of Problem No. 6, which have been in my possession for some months, the authors doubtless wondering what disposal has been made of them. My explanation at the beginning of this article will account for the delay.

We hope our readers will especially note that, in Mr. Mason's first article on "Electrotechnics," he invites them to send in queries about any point not made entirely clear. We hope any reader who finds himself "stuck" will send in as clear and brief a statement of his difficulty as possible. This, of course, applies as well to any other article published in this paper.

Gas motors in Berlin, in 1895, rose from 1,089, with 4,757 horse-power, to 1,123, with 5,144 horse-power. There were thus only 34 new engines last year, against 79 for the year before, but the average size was 11.4 horse-power, against 5.3 for the year before. The tendency is all the while towards larger engines, some of the new ones running up to 60 horse-power.

Gus. C. Henning, M. E., has accepted a position with the Department of Buildings in New York, where his experience and knowledge of materials and tests will be useful in an effort that will be made to correct some of the anomalies that exist in that department.

ELECTRICAL MACHINERY.

Electrotechnics—III.

The Principles of Electricity for Practical Men.

BY FRANK S. MASON.

The last article of this series explained at length the origin and use of the conceptions of current and direction of flow, as applied to electricity. As will shortly be described, it is also customary to speak of magnetic lines of force as flowing and in certain direction.

10. CONDUCTORS AND INSULATORS differ from each other only in degree, since all matter will conduct electricity, an insulator being simply a very poor conductor. It is a remarkable and unfortunate fact that the best insulators are least adapted to structural purposes, being deficient in strength, and in particular in tensile strength. This fact renders the designing of electrical machinery a much more difficult problem than would otherwise be the case. Such as have a fair degree of tensile strength are absorbent of water or liable to carbonization through accidental overheating. It is a suggestive fact that good conductors or insulators of electricity are also the same for heat.

Professor Thompson classes insulators under several heads—thus: (1) Vitreous, including all kinds of glass and slags; (2) Stony, including slate, marble, stoneware, steatite, porcelain, mica, asbestos; (3) Resinous, including shellac, resin, beeswax, pitch, various gums, bitumen, ozokenite; (4) Elastic, including India rubber, gutta percha, ebonite; (5) Oily, including various oils and fats of animal and vegetable origin, as well as solid parafine and petroleum oil; (6) Cellulose, including dry wood and paper, and preparations of paper, such as "fiber" and celluloid. All these materials decrease their resistance enormously as the temperature rises, and in general become very good conductors as soon as any chemical change begins.

Metals increase their resistance as the temperature rises at a rate varying with the metal.

The following table is from data assembled by Professor Thompson:

SUBSTANCE.	Resistance (ohms) of metre length 1 sq. mm. Section.	Relative Conductance.
Metals at 0° C.		
Copper (annealed)	.0157	100
" (hard)	.0160	98.1
Silver (annealed)	.0149	105
" (hard)	.0162	98
Gold	.0208	76
Aluminium (annealed)	.0289	54
Platinum	.0898	17
Iron (pure)	.0964	16
Iron (telegraph wire)	.15	10
Lead	.1963	8.3
Mercury	.9434	1.6
Selenium		$\frac{1}{40{,}000{,}000{,}000}$
Carbon (graphite)		
" (arc light)		$\frac{1}{2200}$
Alloys.		
German-silver (Cu 60, Zn 26, Ni 14)	2076	7.6
Platinum-silver (Pt 67, Ag 33)	.024	6.5
Platinoid (Cu 59, Zn 25.5, Ni 14, W 55)	.325	4.8
Manganin (Cu 84, Ni 12, Mn 3.5)	.475	3.3
Liquids at 18° C.		
Pure water		less than one millionth part.
Dilute H_2SO_4, 5%		
" H_2SO_4, 30%		
" H_2SO_4, 80%		
" $ZnSO_4$, 24%		
" HNO_3, 30%		
Insulators.		
Glass at 20° C		less than one billionth.
Glass at 200° C		
Guttapercha 24° C		

11. SERIES AND PARALLEL CIRCUITS. Events, or material objects, which follow in sequence—that is, one after the other, Indian file, as it were—are grouped in series. Events coincident as to time, or material objects placed side by side, company front as it were, either in fact or effect, are grouped in parallel.

Electrical appliances, whether generators or consumers of current, are arranged, with respect to the conductors, in series or in parallel, or in combinations of the two systems. Here, again, the analogy with water helps a clear exposition of the subject. Two pumps arranged so that the second has its suction connected to the discharge of the first are in series—so arranged, the pressure produced by the second pump is added to that of the first pump; but, clearly, the speed being the same, the second pump adds nothing to the quantity of water passing.

In like manner, it is obvious that two sources of electricity connected in series, the negative pole or suction of the second being connected to the positive pole or delivery of the first, have an analogous action—not, however, an identical action, as there is here nothing comparable with a piston whose speed determines the volume of current. On the contrary, the current is determined by the voltage and resistance, and the increased voltage due to a series connection would increase the current, while, under this increased current, the doubled voltage could not be maintained. At the same time, it is clear that with two generators connected in series, the voltage capacity, so to speak, is the sum of the two; just as with a pump.

The parallel connection is illustrated by two pumps with their suctions connected to the same supply main and their discharges to the same delivery main. The effect is clearly the reverse of the previous arrangement, the pressure produced being no more than each pump alone could produce, while the volume of water pumped is the sum of the delivery of the two pumps.

In a like manner, it is obvious that two sources of electricity connected in parallel, with their positive poles joined to one delivery wire and their negative poles to one return wire, produce analogous results; but here, again, not identical results, for an increased volume of current could not be forced through the old resistance except by an increased voltage. It is clear again, however, that with two generators connected in parallel the current capacity is the sum of the two, as with a pump.

These two illustrations deal with the generation of currents, by means of which energy may be transmitted and work done at a distance. The illustrations following are intended to make clear how that work may be done. Before passing on, it may be desirable to note that the power to do work is the same, whether the generators (so-called) are in series or in parallel, since it matters not whether we have one ampere at a pressure of two volts, or two amperes at a pressure of one volt. Which will best serve our purpose is wholly a matter of expediency, and is determined by the work in hand. Thus, an incandescent lamp requires for best results a small current at a high pressure, as we have seen; while an arc lamp requires a relatively large current at a low pressure.

Returning to our illustrations, imagine a stream having ten falls of 10 feet each, in series, and at each fall a water wheel. In order to drive another wheel (to do the same work as each of the others), another fall of 10 feet would be required. Or, imagine a pipe delivering water under a head of 100 feet to ten water motors, in series, and the same requirement applies. But in neither case would any addition to the volume of water be required for added motors.

In a like manner, it is obvious that arc lamps, for instance, when connected in series (as they are in practice) consume the same volume of current regardless of their number, while each added lamp, by its resistance, adds its quota to the pressure required to force the whole volume of current through the increased resistance, and maintain each light at its proper degree of brilliancy; that is to say, to do its proper and usual amount of work. It follows at once that a series circuit should be fed by a constant volume

of current, the pressure being varied as the resistance is varied. This series connection of arc lamps is illustrated in Fig. 8, where *D* represents the dynamo, *C* the conductor, and *L* the lamps.

Consider, next, a stream having a single fall of 10 feet and ten water wheels ranged across the fall in parallel. Manifestly, the stream must be much larger; at least ten times as much water must flow, to do the same work as the first stream instanced. If another wheel is added, still more water must flow to drive it without robbing the others. Or, imagine a horizontal pipe delivering water

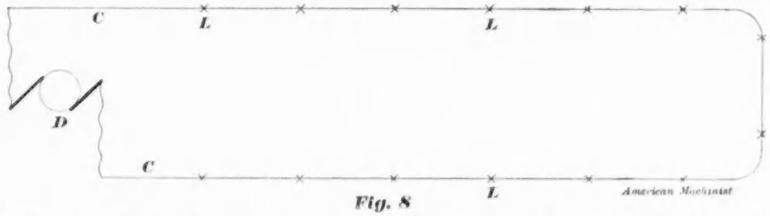


Fig. 8

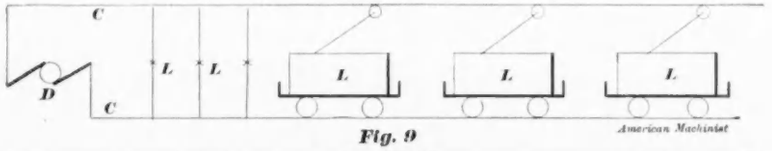


Fig. 9

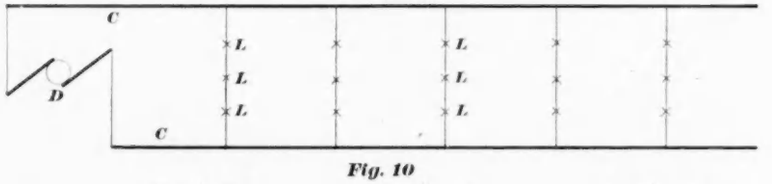


Fig. 10

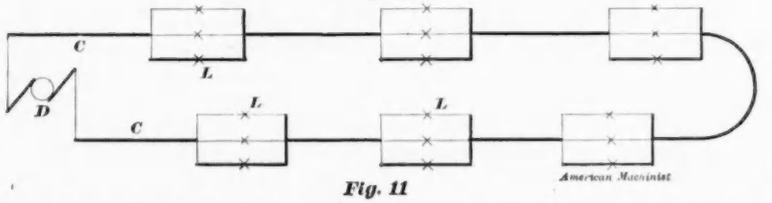


Fig. 11

under a head of 10 feet to ten water motors side by side, or through ten cocks tapped into the pipe. It is clear that if another motor were added, or another cock opened, more water must flow, just as above.

In a like manner, incandescent lamps or trolley cars, when connected in parallel (as they are in practice), require the same voltage, regardless of their number, while each added lamp, by providing a new passage for the current, requires an increased volume of current for its supply. It follows at once that a parallel circuit should be fed by a constant pressure, the volume being varied as the resistance is varied. This parallel connection of incandescent lamps is illustrated in Fig. 9, where, as before, *D* represents the dynamo, *C* the conductor, and *L* the lamps or cars.

The point has been made that generators are grouped in series for a relatively small curent and high voltage; and it has been stated that arc lamps, which require a relatively large current and a low voltage, are grouped in series. This may appear to be a contradiction, but a moment's consideration will discover the propriety of the arrangement. An arc lamp requires a current of, say, ten amperes and a pressure of, say, fifty volts. Suppose sixty lights to be ranged in series—the current will remain at ten amperes, while the pressure required will rise to sixty times fifty, or 3,000 volts. This results in a relatively high pressure and small current, to the generation of which dynamos in series are adapted, as above, and the conducting wire may be of small area, and hence, low cost. But if the lamps were grouped in parallel, the resulting current would be 600 amperes, and the pressure remaining at fifty volts, the conducting wire would require to be so large as to render the cost prohibitive.

The reverse condition obtains in the case of the incandescent lamp. The generators being grouped in parallel to produce a relatively large current at a low pressure, the lamps also are grouped in parallel, and, as a result, the current is split up into a multitude of small streams, each of a small quantity at a relatively high pressure.

The terms parallel, parallel arc, multiple, multiple arc, shunt circuit, derived circuit, connection for quantity (applied to a primary battery), are all synonymous. Parallel series is an arrangement of several series of lamps or other devices parallel with each other, as per Fig. 10; also termed multiple series, etc. Series parallel is an arrangement of lamps or other devices in a series of parallel groups, as in Fig. 11; also termed series multiple, etc.

A Correction.

In the description of the dynamo fieldboring machine which appeared in our issue of January 2d, the design of the machine was credited to Mr. Jno. Riddell, supervisor of machinery and tools at the General Electric Co.'s works, Schenectady. Mr Riddell informs us that this is an error, and that the design should have been credited to Mr. Peter Weber, mechanical superintendent of the Schenectady Works.

Filing Machine for Armatures.

The modern armature is a composite structure. To avoid losses from the generation of useless currents in the core of the armature, the core is laminated—that is, made up of many pieces of sheet metal insulated from one another. These pieces, or punchings, as they are called, are made in one piece when below 36 inches in diameter. Above that diameter they are made in segments—large armatures having as many as seven or eight segments to the circle. The punchings the made in heavy punch presses, with suitable dies. In the completed armature, each circle is separated from its neighbors by insulation. When punchings and insulation are bolted together with spider and flanges, the armature is complete, except for the winding. For this, longitudinal grooves are provided in the surface of the armature, as plainly shown in our larger engraving, Fig. 1, and in detail in Fig. 2. The notches which comprise these grooves are made in the dies with the rest of the punching form. It is essential that these grooves have smooth fair sides, to enable the conductors and their insulation to properly fill them, and to prevent injury to the insulation. When the punchings comprise a complete circle, this merely involves the dressing-off of burrs left by the dies. When the punchings are segmental, there is, necessarily, more or less offsetting to the sides of the grooves when assembled, which offsets, as well as the burrs, must be removed. The grooves are required to be partly closed in on the outside, to provide for the insertion of a wooden wedge or keeper. This prevents the use of a side milling cutter, while the throat of the groove is too small to permit the use of an end mill. Moreover, the divisions between the grooves are of insufficient strength to stand up under the pressure of an end mill. Under these circumstances, the only available means of doing the work is by the file, and formerly it was done with the usual pattern of file and by hand.

Our engravings show a filing machine now exclusively used for this work at the works of the General Electric Co.,

where it was designed and built. The machine is essentially a crank and connecting-rod motion, by which mechanical power supplies the place of muscle. A parallel motion is placed between the connecting rod and the file carrier, whereby the latter is driven in a straight line. The files used are, of course, special, being short and of the same cross section as that of the desired groove.

Fig. 2

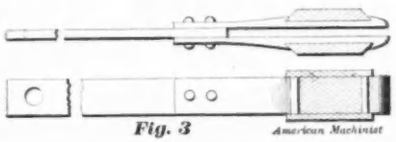
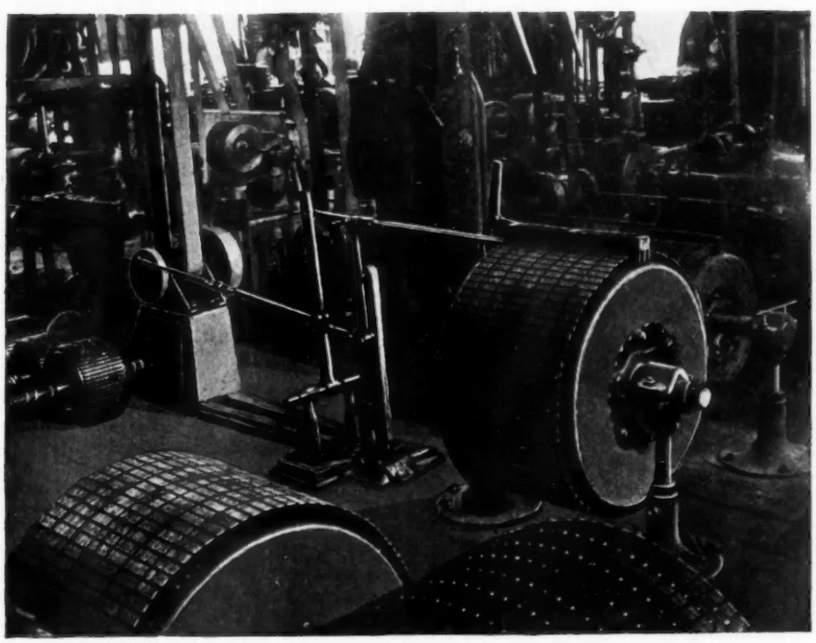


Fig. 3 *American Machinist*



FILING MACHINE FOR ARMATURES.

They are carried in a spring file carrier, shown with the files in Figs. 2 and 3—the former showing a cross section of files and holder in position in the punching slot, while the latter shows a plan and elevation. This spring file carrier provides the necessary pressure against the work.

It will be understood from the large engraving that the files are carried in gangs, three pairs being shown. As many as four or five pairs are used at a time, but it is found that there is no economy in exceeding this number, owing to the time lost in setting and adjusting. The extent to which the machines are used will be judged from the background of Fig. 1, where several are shown at work.

We are indebted to the General Electric Co. for the photograph and sketch from which the engravings were made. We are informed that the cost of the work by this method is less than one-fifth of what it was when done by hand.

The Present Status of the Storage Battery.

The great economy which would result from a successful storage battery or accumulator is beginning to obtain recognition among electrical engineers. The chief sources of economy to be anticipated are, first, the working of the machinery under a steady instead of a widely fluctuating load, and, secondly, the saving in the cost of plant due to the machinery being required to have a capacity equal to the average instead of, as now, the maximum load—this saving in cost of plant being, of course, dependent upon the accumulators costing less than an equivalent plant of machinery.

The American Institute of Electrical Engineers has recently held an extended discussion on this subject, and, in spite of the almost universal failure of these appliances in this country thus far, the balance of opinion was very largely in favor of the batteries. This balance of opinion was, however, largely due to the fact that they seem to be much more successful in Europe than in this country; and a large part of the discussion was directed toward the discovery of the reason for this admitted fact, which certainly is not, at first sight, creditable to American electrical engineers. The leading reasons adduced were the fact that European engineers have not been afraid to call for, and put in, batteries of sufficient capacity to do the work, while here the effort has been to secure economy in first cost at the expense of efficiency and life of plant. Another explanation given for the larger use of the accumulator in Europe, is the fact that the alternating current system is as yet used to a much smaller extent there than here. This, however, can hardly account for the admitted fact that the batteries are much more successful, as batteries, there than here; while the explanation may be a case of "putting the cart before the horse"—that is, instead of the retention of the direct current being the reason for the larger use of the battery, it may well be that the success of the battery has been the reason for retaining the direct current.

Perhaps the most important contribution to the discussion was by Messrs. A. V. Abbott and F. J. Dommerque. These gentlemen presented a diagram illustrating the combined output of current for all the London stations for December 20, 1894, and, taking this as a basis, proceeded to compare the cost of producing current with a plant of the usual type here—that is, one having a capacity in machinery equal to the maximum output, the same being partially shut down when the full current is not needed, with the cost of an equal output produced by a storage battery plant in which the capacity of the machinery is supposed to be equal to the average demand only.

These gentlemen shared the general feeling that the storage battery, as it stands to-day, is a commercial success; but it is doubtful if their conclusion is justified by their figures, while an error in the calculations entirely vitiates both conclusion and figures. They group the various items of expense under the following heads: Cost of fuel, cost of labor, cost of supplies and repairs, interest and depreciation on plant. The last item they take at ten per cent. for engines, dynamos and accumulators. This figure, as applied to accumulators, is far below the average of experience in this country to date; but it is only fair to say that manufacturers are now guaranteeing a figure as small as, or even smaller than this, when their conditions of service are complied with. The exhibits for the two types of plant are as follows:

WITHOUT ACCUMULATOR—ANNUAL COST.

Fuel	$43,146 00
Labor and superintendence	50,370 00
Supplies and repairs	18,000 00
Interest and depreciation on steam plant	113,280 00
Interest and depreciation on electric plant	39,500 00
Total	$264,296 00

WITH ACCUMULATOR—ANNUAL COST.

Fuel	$13,820 00
Labor and superintendence	30,660 00
Supplies and repairs	5,550 00
Interest and depreciation on steam plant	46,784 00

Interest and depreciation on dynamos and accessories...	$17,742 00
Interest and depreciation on accumulators....	109,200 00
Interest and depreciation on accumulator fittings.....	10,920 00
Total.....	$234,676 00

The first thing to attract attention in these exhibits is the great difference in the items of fuel cost, this item for the accumulator plant being about one-third that for the plant without accumulator. This great saving is to be attributed solely to the fact that the accumulator plant gives a steady load to the engines, and, in spite of the fact that the average load on the engines is slightly more with the accumulators than without, owing to the loss of effect due to the accumulators.

That so great a saving is to be expected from this cause is unthinkable, and an analysis of the calculations will disclose the origin of the fallacy. It will be understood, of course, that the load upon a lighting station fluctuates widely during the day, and still more widely between the maximum of December 20th—which has the longest night in the year—and the average of the entire year. The authors state that "the average load throughout the year is 16⅜ per cent. of the maximum;" and in calculating the average horse-power for the year without accumulator, they correctly take the maximum for December 20th—15,700 horse-power—and multiply it by .16375, giving 2,571 average horse-power, on which the calculations of the yearly fuel cost are based, the result being the $43,146 of the table. In calculating the average horse-power for the year with accumulator, the authors first average their diagram for December 20th—introducing an allowance for the accumulator loss—and determine 6,850 as the average horse-power to be supplied for December 20th. They then multiply this 6,850 horse-power by the same factor, .16375, in order to obtain the average horse-power for the year, from which to compute the coal consumption (see Transactions American Institute of Electrical Engineers for November, 1895, page 741, fifth paragraph from the bottom). In other words, in the first case they take this .16375 as the ratio between the average for the year and the maximum for the 20th December, while in the second case they take it as the ratio between the average for the year and the average for the 20th December.

As matters stand, the authors have actually figured for the accumulator plant the coal consumption on $6,850 \times .16375 = 1,121$ horse-power, against 2,571 for the plant without accumulator. In other words, the accumulator plant is made to run on less than half the average power of the non-accumulator plant!

Our authors determine the average watts output of the dynamos without accumulator for December 20th to be 4,200,000, and with accumulator 4,600,000, the ratio being $\frac{46}{42} = \frac{23}{21}$. The best that can be done with the data at hand is to assume that this ratio for December 20th would hold for the entire year—which indeed it should do, closely enough for the purpose. That is $2,571 \times \frac{23}{21} = 2,816$ should be approximately the average horse-power for the year with accumulator. This, however, is a steady load, while the 2,571 is not. Taking the authors' figures of 1½ pounds of coal per hourly horse-power of steady load, gives $41,629 for the yearly coal bill with accumulator and steady load, against their determination of $43,146 for no accumulator and fluctuating load. Inserting the above value for the accumulator plant in the tabular exhibit, gives a total yearly outlay of $262,485, and practically wipes out the calculated saving.

If we go still further in the inquiry, we shall find that the cause of the failure lies in the great cost of the accumulators, which not only do not cheapen the first cost of the plant, but, on the other hand, increase it. Now, if the money must be invested, it might as well go into machinery as accumulators; and as the accumulators do not reduce the capital expenditure, the only avenues of saving left are through the coal bill, labor and repairs, and the savings from these sources do not aggregate a large amount. The leading question, why accumulators are more successful in Europe than here, still remains unanswered.

The Care of Isolated Electric Lighting Plants.

BY PETER H. BULLOCK.

It has been said that some are born great, some achieve greatness, while some have greatness thrust upon them. There is a certain application of this quotation to those having charge of electric plants. A very few may have been born electricians, many have achieved the art of management, while others have had the responsibility thrust upon them in addition and supplementary to their other duties. The writer finds himself in the latter category, and with very interesting company. When you find a middle aged man in such a position it will often be found to be a case of "have to." A very efficient superintendent of a certain gas and electric light company told me this was the reason why he "booked up" on electrical matters.

He was an educated gas engineer, but when his company absorbed the electric franchise he came into control, and studiously acquired the necessary technical knowledge for intelligently managing the electrical branches of the enterprise. Those for whom this paper is intended are, however, of that more numerous class who have to acquire the art of caring for and operating electrical apparatus, and who perhaps have little opportunity or inclination for becoming versed in the science upon which it is constructed.

To illustrate my idea of how a man who is about to have the care of such apparatus thrust upon him should "hold his mouth," I will copy part of a letter just written to a friend who is in that position, and who has asked me for advice and information.

"You are to install a lighting plant and wish to profit by my mistakes, which have been many and flagrant. It will be a good plan for you to visit all of the other plants in your vicinity and look up the mistakes in them, so you can learn how not to do certain things. It is just as necessary to know the rocks as the deep water in a channel you are about to navigate. Divest your mind of the idea that there is any mystery about operating the dynamos and simply use your horse sense in everything you run up against. Don't try to fathom the science of it; Edison nor Tesla haven't done that yet; just acquire the art of making the thing go right, and when you can do that well, you will see more into the reasons why you do certain things, and why desired results follow.

"Put the belts on to the machines and run them just as you would any other piece of mechanical apparatus of similar weight and speed. If fields are not connected and the brushes not in contact with the commutator, the dynamo is simply a machine and you know as much about running it as any electrician. The man who is to set up the apparatus will show you all about adjusting brushes, etc.; that is, if he is a square man and is not looking for an opening to run the plant himself. Symptoms of this would be an air of mystery, the use of technical language, and oft repeated stories of disaster to other plants.

"Don't get rattled at all the wires, cables and instruments at the switch board; they are all useful and most of them absolutely necessary, and they are no more complicated than the piping about your plant with which you are so familiar as to almost invite contempt.

"You will find that there is an armature made to revolve between two or more 'fields,' and that as the latter become magnetized they have an attraction that tends to hold the armature from turning, but the belt knows a 'good thing' and 'pushes it along,' thus generating current which the winding carries to the commutator, where it is picked off by the brushes and passed along to the circuit. If your circuit is kept whole and the machine in good order, there is less need of trouble with it than with a buzz saw.

"Don't be afraid of the brown gloss on your commutator; it is better than raw

copper. Read all of the best mechanical papers and catch on to all the kinks you can."

The above was written to a plain, common-sense and conscientious engineer. He will be all right; he understands handling machinery and will acquire the art of caring for his new installation.

What follows regarding dynamos and their use is mostly mechanical, although mechanical effects can be produced by electrical action.

Commutators will get cut and worn until sandpapering will no longer suffice, and they must be turned. To do this, either the whole shaft must be taken to a lathe, or the commutator must be disconnected and turned on an arbor, or there must be appliances for turning it off in position. To take out an armature shaft means more or less work, according to the size and design of the machine. In some makes the designer seems to have neglected to provide any decent means for such work, while in others even efficiency is sacrificed to ease of dismemberment. To take the commutator from the armature and replace it correctly requires skill. It can be turned apparently true on an arbor, but when it is put back every imperfection of lathe and arbor will be multiplied and the "latter state" of that commutator will be worse than the first. Turning off in position, however, leaves nothing to be wished for if properly done, but to do it properly there is required something besides a chasing tool and a gas pipe rest. Briefly, the requirements are a slide rest, the right speed and the "know how." The last requirement includes the second, but does not provide the tools. Most builders can furnish, if required, slide rests specially made to clamp on to the base or frame of their dynamos so as to bring the tool post to the proper position for doing the work. If a special rig is not to be had, the slide rest and tool post can be taken from a lathe and fastened to a plank bolted to the frame and in connection with the "know how" a good job can be done.

Many electric light engines cannot be run slow enough with the regular pulleys to properly turn a commutator. Different methods will suggest themselves for accomplishing this purpose, as, for instance, a small engine that can be quickly bolted to the floor opposite the dynamo and having a small pulley on the crank shaft belted directly to the dynamo pulley. A 3x5 upright weighing only about 100 pounds will do the work all right. A few feet of steam hose is very convenient for making easy and quick connections to some near-by steam pipe. In some cases a length of light shaft can be erected and pulleys arranged so that the regular engine can be run slow enough to do the work.

For a commutator 8 inches in diameter a speed of 50 revolutions per minute will answer well. The tool must be very hard and sharp to cleanly cut the soft copper and hard mica insulation, as a dull tool will pull the copper across from one segment to the next. I have also found it better to turn the commutator in the direction opposite to that in which it regularly runs, for then the sharp tool will better get under and pare off any thin places there may be where the brushes have spun the metal into and across the insulation. After the commutator is turned true take a float file and draw lengthwise of the segments over the lines of mica. This will remove any little particles of copper that may have lodged between them. Some use fine sandpaper after truing and draw filing, but if the copper is clean I see no good reason for this. Of course, there should be as little metal removed as will get the commutator true, for, like the water that has passed the mill, the lamps will never light with the copper that is gone.

LETTERS FROM PRACTICAL MEN.

The Air Pumps of the "Arctic."

Editor American Machinist:

Mr. Harrison's calculations on the "Arctic's" air pumps are precisely of the sort used by the builders of that vessel's machinery, and are totally at fault, and the fact that "designers did not enlarge the suction pipes of bilge injections after the 'Arctic's' disaster" pointed out that such pipes were too small, beautifully illustrates the mulish and criminal stubbornness of some of the old time engineers.

Mr. Harrison says that a jet air pump should not be filled over one-third full of water, as otherwise the air would not be extracted.

It would be refreshing if some one would point out how free air could pass down through the flood of water in a jet condenser, and forcing its way through the sealed pump suction, reach the barrel of the pump.

As a matter of fact, the spray from the injection roses absorbed such free air, and carried it, in solution, into the pump, otherwise it never would have been extracted, and there is no earthly reason why a pump should break down when full of water, any more readily than when but partly filled.

If full, there would be a steady pressure on the bucket, while, if partly empty, the water would strike the discharge valves and plate a heavy blow at each stroke.

Yes, the old time air pumps were "tender and delicate structures." They were designed by "rule of thumb," and those parts which should have been strong were light, while portions that should have been light were enormously heavy; and when a break-down occurred it was religiously attributed to "a grate bar having floated into the suction," and the fact that such suction pipes were guarded by a strainer was not mentioned in putting the excuse, and I notice that Mr. H. does not refer to the use of such devices when speaking (or rather writing) of the liability of a pump's becoming clogged.

Also, when referring to the absolute necessity of the suction being entirely under water, he does not mention that the inlet was always placed in a well left or cut between the floor timbers of the ship, and the fact that the engine room and fire room floor plates were usually two or three feet above the ship's bottom timbers—to clear the keelson— and that with water up to such floors there would be ample head for flow to the suction pipe, seems entirely to have escaped him.

Even allowing that a jet condenser air pump should be but one-third filled with water, as asserted by Mr. Harrison, his own figures show that the "Arctic's" suction pipe was but about six tenths (6-10) of its proper size. In any elementary textbook on hydraulics, the co-efficient of contraction of such orifices will be found as reducing the pipe area to six tenths its actual value, and if 7 inches would do for a solid column of inlet water, the actual pipe would be slightly over 9 inches diameter to allow such a solid flow.

As to the statement that separate air and water pumps would not work in a condenser by reason of the dry air pump leaking, it is strange that such should be the case when thousands of reliable people find no difficulty in using dry air pumps in the shape of compressors that deliver air at from 50 to 200 pounds per square inch.

Verily times have changed since those precious Erie experiments (quoted by Mr. H. as being models of science) were made, for those tests formed the groundwork of Isherwood's tirade against any expansion, which he stated gave but about 20 per cent. economy at best over that due to carrying steam full stroke, and yet the engineers of the present day declare that expansion is the main reason for the small coal consumption in modern engines.

J. G. Sayce.

New York City.

Strength of Hydraulic Cylinders.

Editor American Machinist:

The letter of Mr. E. W. Naylor on the "Strength of Hydraulic Cylinders," which appeared in the "American Machinist" for November 14th, does not, by any means, dispose of the matter under discussion. The formula which he uses is, I think, now generally held to be only applicable to cases in which the thickness of the cylinder wall is small as compared with the diameter, and while quite suitable for the particular case presented by "X. P., of Louisville," does not merit general reliance being placed upon it, as Mr. Naylor appears to think. Of course there are rules and formulae innumerable for determining the strength of hydraulic cylin-

ders, but as far as my experience goes no formula can be considered reliable which does not take into account the variation of tension which exists throughout the thickness of the walls of the cylinder. Taking this view of the matter the following expression may be used for determining the tension in pounds per square inch on the innermost layer of the material:

$$P = p\,\frac{R^2 + r^2}{R^2 - r^2}.$$

R being the outer, and r the inner radii in inches; p, the pressure within the cylinder, and P the resulting tensile stress on the innermost layer of the metal. By applying this formula to a number of cases met with in actual practice, I find that the allowable stress for cast-steel cylinders is materially higher than that allowed by Mr. Naylor, viz., 10,000 pounds per square inch. I give below a number of actual examples as made by a first-class firm of steel founders for working pressures of two tons and three tons per square inch respectively, and in every case it will be seen that a far higher stress than 10,000 pounds is allowed on the material, even if calculated by the thin tube formula of Mr. Naylor.

Diameter of Rim. Inches.	Thickness for Two Tons Working Pressure.	Tensile Stress. Tons.	Thickness for Three Tons Working Pressure.	Tensile Stress. Tons.
8	1½	6.40	1⅝	8.18
9	1⅝	6.69	2	8.52
10	1¾	6.86	2¼	8.44
11	1⅞	7.01	2⅜	8.71
12	2	7.14	2½	8.96
13	2¼	6.92	2¾	8.85
14	2½	6.74	3	8.76
15	2¾	6.61	3¼	8.69
16	2⅞	6.71	3⅜	8.87
18	3	7.14	3½	9.46

Naturally a good deal depends upon other circumstances than the diameter and pressure—in particular due regard must be paid to the ratio of length to diameter, and in hydraulic press cylinders to the dimensions of the cylinder head. It will be found, however, that even when making ample allowance for these and other minor influences, a working stress of 13,000 to 15,000 pounds per square inch might safely be allowed on good steel castings.

In the Lancashire cotton district, in the hydraulic packing presses used for pressing cotton piece goods for export, it is not unusual to find the material stressed, at its inner layer, to about 20,000 pounds per square inch. This steel used for the press cylinders has an ultimate tensile strength of from 28 to 35 tons per square inch, and although there are many hundreds of these presses constantly at work, failure through bursting of the cylinders is rare. In the earlier days, when cast-iron was the only available material, the constant demand of exporters for presses which would pack the goods more tightly was a source of serious trouble to the makers. With a press cylinder of 14 inches internal diameter a thickness of 10 inches was eventually reached, but the stress of about 9,000 pounds per square inch on the inner layer of metal proved to be more than it would stand, and fractures were neither few nor far between.

Attempts were made to add to the strength by still further augmenting the thickness, but this was found to have no material effect in increasing the strength—a fact which furnishes an experimental falsification of the formula used by Mr. Naylor when applied to the calculation of the strength of thick tubes such as are here considered. M. E.

Small Rose Reamers.

Editor American Machinist:

In your issue of November 7th, Mr. Oberlin Smith asks: "Who knows much about reamers, anyway?" I don't know much, but will tell what little I do know about them, and perhaps some other fellow will tell the rest.

I have to use fluted reamers occasionally, but the greater part of my work is done with rose reamers from ⅜-inch diameter down to about 1-20-inch. These are not ordinarily considered as good as a fluted reamer, but they possess some advantages peculiar to themselves, and I

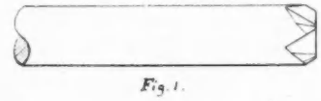


Fig. 1.

Fig. 2.

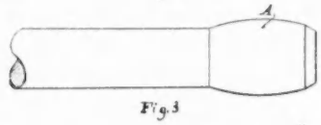


Fig. 3

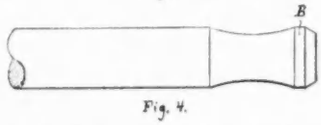


Fig. 4.

prefer them where the conditions to be met are not too exacting. I only harden the end for a distance of about one and one-half or two times the diameter, and leave it perfectly hard without drawing the temper at all, which is safe, as there are no flutes to impair the torsional strength, and being so hard, they will ream a great many holes before they get too dull to use. If the teeth, instead of being in a plane parallel with the axis, are filed at an angle, as I have attempted to show in Figs. 1 and 2, you get a sort of draw cut, similar to the action of a spiral fluted reamer, and the chips are also pushed ahead with greater facility. Of course, a rose reamer will not ream a long hole continuously, as a fluted reamer will, but has to be backed out occasionally and the chips removed. However, I imagine that with the quasi-spiral teeth the backing-out process need not be so frequently repeated. I used to make these reamers out of a piece of drill rod just as it comes, but the hardening process swells it into a shape shown very much exaggerated in Fig. 3, and after reaming a few holes in unannealed tool steel the reamer would begin to bind at the parts marked *A* long before the teeth got dull, so now I either turn or file a very slightly hollowing place in the blank, just back of where the teeth will be (shown exaggerated in Fig. 4), leaving a narrow strip, *B*, of the original surface of the rod to give me the size, and this seems to remedy the binding trouble. One of the advantages of a rose reamer over one that is fluted, is that the former so completely fills the hole that there isn't very much chance for it to chatter, so the hollow part should not be turned further back than the hardening is to extend; also, it should not be turned deep enough to collect chips and score the finished hole. In making these reamers, I turn the bevel on the end and copper-plate it to show when the teeth are filed up to a sharp edge. Then I put it in the vise and file the teeth in, first putting a small clamp dog on shank of reamer, which answers as a sufficiently accurate index for four teeth—the bars of the dog being in a horizontal plane while two of the teeth are filed, and in a vertical plane for the other two teeth. They are so easy to make that I seldom grind them when dull, but cut off all that has been hardened and make a new one. The burr thrown up by the file may be taken off with a scraper before hardening, or with an oilstone slip afterwards, but it has to be done very carefully, and I generally try them on some scrap piece first to see if they are right. When properly made and used with oil they produce a fairly smooth hole in tool or machinery steel, cast iron or brass, that will be a running fit on the wire from which the reamer is made. For a tight-fit reamer I file down standard-sized wire till it is about .001 inch below the size, and make a reamer of that, cutting off the front end of piece, after filing, to avoid any of the rounding-over effect that is usually produced by a file used near the end of a rod. I generally make my tight-fit reamers shorter than those for loose fits of the same nominal size, so as to distinguish them without marking.

WALTER GRIBBEN.

Type-Setting and Adding-Machine Contests.

Editor American Machinist:

Mr. Redfield's reply to my criticism of the record of 78,000 ems set per seven hours, is very amusing. He shows that a first-class regular workman will average less than half that "cooked" exhibition rate of speed. His description of the proposed gear-cutting contest is so near the truth that he must have witnessed some actual performance of that kind.

The published records of the number of inches that have been cut by actual trial are very troublesome to us practical gear cutters, for we are not selling machines and not working for exhibition purposes, and cannot come anywhere near the exhibition record. Our customers sometimes ask us some very disagreeable questions when they get their bills and figure out the time it ought to have taken to do the work charged for. A man has a lot of gears to be cut, and a circular showing that so many inches per minute have been cut by a certain machine. If he buys the machine he will soon find that there is a difference between promise and performance, but he does not buy the machine. He expects the gear cutter to make a price for the job that is in accordance with the exhibition rate; and not even the maker of the machine will do so.

It is the same in other lines, particularly in that of adding machines, in which I am interested and know whereof I speak. An adding machine is covered with small keys, each with a 9 or a 3 or other figure on it, and the operator adds by punching the right key in the right column just the right amount. If he hits the wrong key, or the right key in the wrong column, or the right key in the right column and hits it the wrong way, he misses.

As the keys depress nine different distances, and with nine different resistances averaging about one pound, and there are seventy or more keys to choose from and hit the right key every time, a good operator will average about two keys per second. If he does more than that he must be a regular Paderewski in natural ability and amount of practice, or else he does not want his results compared with the truth. Published adding-machine speeds sometimes require from seven to eighteen keys thumped per second, and anyone who will punch a single chalk mark on his soft pantaloons at that rate will get a good idea of the special education and natural skill required to keep it up on the actual machine.

If these performances were published as extreme cases no one could find any fault, but they are sent out as averages, and allow me to say that that is one way of lying. Such harsh language is disagreeable, to be sure, but it is necessary; for the public believes whatever it reads, and the manufacturer who will not show up the practice as a fraud, or out-lie all the other liars, must take a back seat.

GEORGE B. GRANT.

Lexington, Mass.

Case-Hardening.

Editor American Machinist:

You asked in your December 12th issue for information about case-hardening in a small way. I send you description of our arrangement.

Take any size of gas pipe and cut off the length you want, then square the ends and make two heads. These should be cast iron, for it won't warp out of shape like wrought iron or steel, and should be 1 inch thick, with a groove cut in them ¼ inch deep for pipe to go in. Fasten heads to pipe with four ½ inch pins riveted to outside of pipe and running them through heads, with keys to hold on heads. In this groove put plumbago or fire-clay, so as to make it tight.

For a furnace to use coke, take the pipe and stand it on end, and build a

Fig. 1

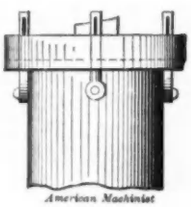


Fig. 2

wall around it 6 inches from sides, and in this space put your coke. Don't leave many air holes or you will get it too hot. If wood is to be burned, and the pipe is 8 inches diameter, 36 inches long, dig a hole 30 inches long, 18 inches wide, 6 inches deep, and lay three bars of iron 1½ inches diameter across this space; lay on pipe and put in old grates or fire-brick for sides, and build up a good fire all around it. The coals will soon fill up under it, and with a little attention you can do a good job. Keep the pipe a bright cherry red. To handle pipe we use a pair of tongs like Fig. 1.

For the benefit of those who wish to start case-hardening, I will give them a few pointers. Don't think because machinery steel is closer grain than iron that it will be best to case-harden, for it will not take the carbon in as deep as common wrought iron and will not be any better. When you open the pipe, pick each piece up separately and plunge it in cold water. We use a small tub and run in a 2-inch stream of water, so as to insure it being cold. The danger of dumping the whole lot at once, is of leaving some of the compound in the bushings, or their being covered up and not cooling quick enough. If such a thing happens, they can be hardened by reheating them in a forge and plunging them in cold water.

In packing articles to case-harden they should be at least ½ inch apart, and pack the compound solid around them; and if the pipe should not be full, fill up with fire-clay if you wish to save compound.

We use hydro-carbonated bone black and heat ten hours, and the carbon penetrates hammered iron 1-16-inch, which is far enough for us.

EDWIN N. WEIST,

M. & N. E. R.R. Shops, Manistee, Mich.

Usefulness of Bound Volumes.

Editor American Machinist:

The "American Machinist," in its new form, is a very decided improvement in every way, more especially in its adaptability for the library.

I think it would be well to call the attention of your readers to the inestimable value of bound volumes. Fully half the value of a technical journal like yours is lost by allowing the numbers to get scattered after being read, or, if kept, to accumulate in some closet or attic in such a manner as to be perfectly useless for ready reference.

The simplest and, in my opinion, the best way is to file each number, when read, in a binder, and then at the end of each year have them bound in uniform style, and by this means secure an accessible fund of invaluable information. That this is not more generally done seems strange, but, from personal observation, I know that such is the case at least amongst mechanics in this part of the country.

F. THORNELY.

Dubuque, Ia.

Oil on Reamers and Taps.

Editor American Machinist:

As "H. E. S." has requested the experience of mechanics on using oil for reaming and tapping cast iron, I would say that for reaming cast iron I think the oil worse than useless. If the reamer is a little dull, and oil is used, the reamer will not cut its full size in the hole, which will tend to still further dull the reamer.

But for tapping cast iron I think oil should be used, especially when tapping a thread of fine pitch, as the friction between the threads of the tap and the work is such that a fine thread is liable to break out in places unless oil is used.

J. T. G.

Work on Planers.

Editor American Machinist:

To your interesting article, "Something About Levers," might be appended a little advice to your correspondent, "W. G. B.," that he depend on stops in the planer platen, and not on clamps, to hold the work. Where stops are used, the clamps do not need to be so tight.

I think your statement in November 28th issue, relating to the fracture in malleable iron, will apply to the average malleable casting, except very thin ones.

Moline, Ill. W. E. C.

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Every correspondent, in order to secure attention, must give his full name and address; not necessarily for publication, but as a guarantee of good faith.*

☞ *All communications for or relating to the reading columns should be addressed to the editor. All other communications to the company, as above.*

☞ *Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

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Commissions and Rake-offs—Consulting Engineers or Salesmen; Which?

That the professional engineer does not occupy a very satisfactory position in his relationship to the client on the one hand, and the manufacturer of machinery on the other, is quite clearly indicated by the complaints that come to the surface from time to time. The principal cause of trouble seems to be that many of the so-called consulting engineers are more or less engaged in the business of selling goods on commission. Some of these are the regularly accredited representatives of manufacturers, and, as such, are certainly entitled to make a profit on every sale made; but the use by them of a title that would indicate that they are in the business of rendering professional services, would seem misleading, if not a direct act of deception.

The fact that the local agents of manufacturing concerns do use the terms "consulting engineer," "mechanical engineer," "electrical engineer," etc., leads to confusion and doubt as to who are professional men and who are merely salesmen, engaged in furnishing advice and opinions for the purpose of furthering their special interests. It also leads to the very reprehensible practice of professional engineers accepting bribes in the form of commissions on machinery and material purchased by them for their clients.

That many consulting engineers actually do accept such bribes, and even demand them when not voluntarily offered, is painfully evident from the replies received from a series of inquiries sent to prominent manufacturers in different parts of the country. These manufacturers unite in condemning the practice, and a number of them characterize it as a species of blackmail to which circumstances compel them to submit. A surprising feature of this condition of affairs is the names of those who demand commissions when acting as consulting engineers, many of whom, from their standing, would not be suspected of such practices.

Professional engineers who take commissions doubtless excuse themselves on the ground that the consulting business is not sufficiently remunerative to supply a respectable living without being supplemented in this way. Perhaps this may be true in many instances, but the fact is not a sufficient excuse for indulging in practices that are all but universally condemned as dishonest. The nature of the relationship between the engineer and his client is one that calls for the best services that the former can render, and for which he should receive a compensation commensurate with his ability and standing. For him to accept a small fee, and then to make up the difference by dark-lantern methods, is not only dishonest to those directly interested, but is an injury to his more honorable competitor, and tends to bring discredit upon the profession as a whole.

That improper commissions increase the selling price of machinery is clearly indicated by the testimony of the builder of a high-grade engine, who says that it sometimes costs more for the necessary bribes than it does to build the engine. In some cases every one, from the consulting engineer down to the fireman and helper, has to be "seen," or the engine does not have a fair chance. It does not require a very extended amount of reasoning to see that these practices are an injury to the purchasers, the manufacturers and the workmen in the shops—in fact, an injury to everyone except those who are the immediate recipients of these perquisites.

To what extent this form of boodling exists among engineers is somewhat uncertain, but that it does exist there is ample evidence. The remedy is easy to see, but difficult of application. Something may be done by appeals to the honor of engineers; but much more may be accomplished by the manufacturers, if they will discourage all improper commissions and refuse to permit their local representatives to pose before the public as "consulting engineers," "mechanical engineers," or under any other title that might imply that they are something else than what they really are—salesmen. As manufacturers are among the principal sufferers by the payment of improper commissions, it would seem that self-interest would prompt them to do this themselves and encourage it in others.

Chemical Analysis of Iron and Steel.

The belief is quite common, especially among those who have had little or no experience in the practical work of steel manufacture, that a thorough chemical analysis will indicate precisely the character and quality of steel; yet those who are more familiar with such matters have long been aware that this is not at all the case, and it is a fact that two different brands of steel which will appear to be precisely identical, so far as the most rigid chemical analysis can show, will be totally different when put into service, and will give different results under physical test.

Nearly, if not quite, all the prominent steel makers of this country have made steel springs to the specifications of the Pennsylvania Railroad. These specifications require that the steel shall show a

certain chemical analysis; and yet, it is a fact that one certain maker, who makes steel which conforms to the requirements precisely, so far as chemical test can determine, yet not more closely than the other makers conform to it, gets, in the open market, a considerably higher price for his springs than any other maker. And the railroad company in question has demonstrated to its satisfaction that it can afford to pay this higher price, because the springs, notwithstanding that chemical analysis shows them to be precisely identical with the others, give enough better results in service to more than justify the higher price.

It is the same with fine irons. Take Swedish iron as an example. It is well known that this iron possesses certain qualities not possessed by any other known iron, and finer steel can be made of it than can be made of any other iron known; yet irons have been produced in the United States which, so far as the most exhaustive chemical tests can show, are precisely identical with this Swedish iron.

In short, it seems to be clearly demonstrable that a chemical test will not tell us all we must know about such matters. But recently the microscope has been applied to this work; and it has been found that where chemical analysis fails to show the difference between two specimens of steel or iron, the microscope will show a very decided difference between them, and the difference thus shown seems to bear some relation, more or less exact, to the differences that are shown by the same specimens under physical test.

Expert Tests vs. Everyday Practice.

In another column, Mr. Geo. B. Grant calls attention to a difficulty which is constantly arising, not only in connection with type-setting and calculating machines, but with nearly all machines in which the amount of product per hour, or per day, is an important feature, and has an important influence upon sales. In steam engines and boilers, we all know that the economy developed during an expert test is usually by no means representative of what the plant will do under ordinary running conditions; but at the same time it is evident that when a manufacturer is testing a machine to see what its capabilities are, there is only one way for him to do that, and that is to make the machine do all it is capable of doing. If he tests it under fair conditions and misrepresents nothing, then the results show what the machine is capable of doing, and a purchaser or user can approach more or less closely to this performance in accordance with the conditions under which he operates the machine. If the attempt were made to restrict the conditions under which tests should be made, to make them conform more nearly to everyday operating practice, then we think still greater difficulties would arise, because nobody knows what ordinary, everyday practice is. It differs widely in different localities, and under different circumstances, and therefore we think it is proper for a manufacturer when testing his machine to make it do all it is capable of doing; but he should then distinctly state that this is a test designed to show the extreme capabilities of the machine under the most favorable conditions, and that everyday working conditions will not produce exactly the same results, but only results approaching these in proportion as the conditions approach the conditions of the test.

Nobody expects a naval vessel to regularly cruise at acceptance trial speed; but the trial shows what the vessel can do, and the proper allowances can be made by those whose business it is to judge of such things. The same principle must necessarily apply to other machines.

Questions and Answers.

Name and address of writer must accompany every question

Questions must pertain to our specialties and must be of general interest.

We cannot undertake to answer questions by mail.

(12) C. H., Waverley, Ia., writes: Please give a method of dipping a cast-steel bowl in a bath of tin and have it come out smooth and tinned all over. I have tried it, but in vain. A.—The entire surface to be tinned must be bright, clean metal, secured by grinding or otherwise. Dip the bowl first into a bath of muriatic acid in which there has been dissolved all the zinc that it will take. Then dip the bowl into the melted tin, allowing it to stay there until it is thoroughly heated. Drain or wipe off all loose drops of tin.

(13) L. J. F., Ausable Forks, N. Y., writes: I am using a National feed-water heater, which condenses the steam, giving me about a 1-inch stream. I want to pump that water back to the boilers. Would it cause the boilers to foam, or would it be injurious in any way? A.—The water will be all right if the oil is extracted. Pass it through a horizontal box, say 2 feet square and 10 feet long, and filled with "excelsior." The excelsior must be renewed occasionally. Hay or straw may be used instead, but the excelsior is to be preferred.

(14) C. W. K., Brooklyn, writes: Will you kindly give me a formula for computing the horse-power of worms and worm wheels? I have found in most handbooks, formulas for gears of other kinds, but not for those asked for. A.—To cover this subject would require several formulas. The strength of the teeth of the worm wheel would obviously be about the same as for spur gears subjected to the same strain. Computations as to the power realized in a given case, or as to the power required for a certain service, can only be roughly approximated on account of the uncertain, but always great, friction loss. If our correspondent will submit a specific case, we may be able to show him how to treat it.

(15) W. L., Pittston, Pa., writes: Referring to the Hornsby-Akroyd oil engine, which you gave an account of on August 1st, 1895, I wish to ask to what pressure the air that is admitted in Fig. 1 is compressed to in Fig. 2, or if it is necessary to have higher than atmospheric pressure (all other conditions the same) to accomplish an explosion. A.—The indicator card, Fig. 4, given in connection with the other diagrams, shows that the free air with which the cylinder is filled is compressed by the return stroke of the piston to about 30 pounds (the scale of the card being 40) before the explosion occurs, and the heat generated by the compression, in addition to the heat already in the retort, determines the time of the explosion; so it is not the increased pressure that directly causes the explosion, but the higher temperature accompanying the higher pressure.

(16) N. J. A. W. writes: Please give us the horse-power of the following engines: 1. Cylinder 5-inch diameter, 8-inch stroke, plain slide valve, cut-off at four-fifths of stroke, revolutions 240 per minute, boiler pressure 100 pounds. 2. Cylinder 5-inch diameter, 8-inch stroke, double-ported balance slide valve, cut-off two-thirds of stroke, revolutions 240 per minute, boiler pressure 125 pounds. 3. Tandem compound engine; high pressure cylinder 5-inch diameter, 8-inch stroke; low-pressure cylinder 8-inch diameter, 8-inch stroke, cut-off two-thirds of stroke, revolutions 240 per minute, boiler pressure 125 pounds. Also give the proportionate consumption of water for each engine when running at its full capacity. A.—Effective horse-power, 15.4; water consumption, 52.4 pounds per horse-power per hour. 2. Effective horse-power, 18.8; water consumption, 43 pounds per horse-power per hour. 3. Effective horse-power, 25; water consumption, 32 pounds per horse-power per hour. We know nothing of the actual engines which our correspondent may have had in view, and the results realized may vary quite widely from our figures, so many conditions combining to modify the case.

Glass for Bearings.

Should not something more be done than is being done, experimentally if not practically, in the use of glass for bearings? Some experts speak highly of it for wood-working machinery. It is said to require less care than any other material; running with little oil and keeping cool. In methods of shaping and cutting glass, such advances have been made that it should be now a comparatively simple matter to adapt it to general use. Glass sleeves could, of course, be easily furnished, perfectly true both inside and out; and there are numerous places where such sleeves, bushes, thimbles, or whatever they might be called, could probably be employed with great satisfaction. Glass would probably be better adapted to high speeds than to heavy loads.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant: see page 31.

Forming Lathes, Mer.Mach. Tool Co.,Meriden,Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, write Walter Donaldson & Co., Wash, D.C.

Model making and electrical experimental work. F. W. Gardam & Co., 58 Ann st., N. Y.

Engine castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Aluminum and Brass Castings, Machinery, Name Plates. Twining Campbell, Paterson, N. J.

Brazing Wire and Bicycle Supplies; repairers and manufacturers; see Haines' ad. Ref. index.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 32 Cortlandt st., N.Y.

Just issued—Catalog No. 8. Mailed Free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill, 913 Tilden street, Saginaw, Mich.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N. Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, Tolland, Conn.

Thin emery wheels, for cutting slots, etc., a specialty. The Tanite Co., Stroudsburg, Pa.; 161 Washington street, New York; 139 East Pearl street, Cincinnati, O.

Three valuable books by Prof. N. Hawkins—"Calculations," $2.50; "Instructions for the Boiler Room," $2.50; "Aids to Engineers' Examinations," $2. Sold on installments. Write for terms and catalog. Theo. Audel & Co., 91 Liberty St., N. Y.

Some Recent Inventions in Metal-Working Tools and Machinery.

For those to whom the making of formed milling cutters means a tedious process of turning, milling, relieving, tempering and grinding, the following patent, recently issued to Mr. C. C. Tyler, of Hartford, Conn., will contain interest.

Figs. 8, 9 and 10 are respectively a plan view, and sections on b—b and c—c of the plan, showing a machine for swaging or striking up the teeth on forged cutter-blanks, the device being an improvement on a similar invention of Mr. Tyler.

The blank, besides its usual axial bore, is formed with concentric circles of depressions on each side, as shown at 10′ (Fig. 10), to enable it to be more firmly gripped during the swaging stroke of the forming tool T.

As best seen in Fig. 1, power applied at P is transmitted through shaft J, pinion 63, gears 63′, 64 and 65, to the shafts J^1 and J^2, journaled at right angles in the main frame. On J^2 is the toggle M for actuating the forming tool, and on J^1 the toggle O for imparting an additional grip to the blank-holder at the instant of forming the tooth.

Referring to Figs. 8 and 9, the blank is inserted between and held by the revoluble clamps 2 and 3 in the following manner: 12 is a block capable of slight longitudinal movement in the bearing 13, but at the same time attached, by a screw and slot, to the hinged cover of said bearing, so as to be swung out of alignment with 3 to allow the retraction of the latter and the insertion of the blank. A clamping-rod, 7, driven by a hand-wheel 8, screws into the inner end of 3, and forms a permanent clamp for the blank during the indexing. Projections on 2 and 3 for engaging the

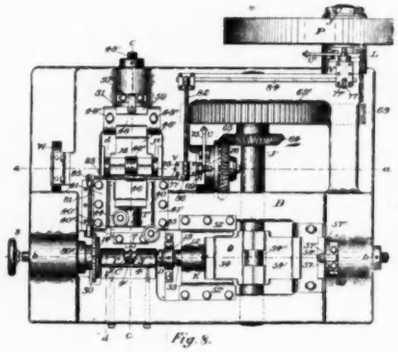

Fig. 8.

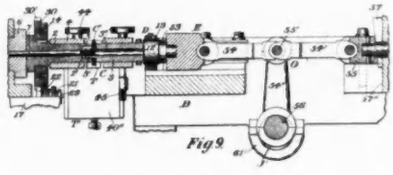

Fig 9

depressions 10′ of the blank are somewhat imperfectly shown in Fig. 9. After the blank is thus clamped, the block 12 is swung into place to receive and transmit the additional clamping pressure of the toggle O. The guides for the head E of this toggle, as well as the manner of driving and adjusting it, are clearly illustrated in Fig. 9.

As shown by Fig. 10, the toggle M and the head-block T^1 are similarly actuated, adjusted and guided. The tool T is capable of both vertical and lateral adjustment on the head T^1. The slide 40′ is moved

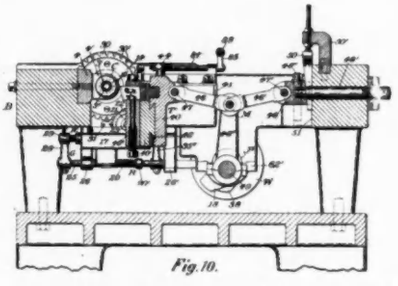

Fig. 10.

laterally by a connected rack (not shown), which meshes with a pinion on the lower end of the shaft 44. Hand-wheel 45 (Fig. 8) vertically adjusts 40″ on 40′, both, of course, being locked after such adjustment.

In addition to actuating toggle M, the shaft J^2 carries cams 18 and 38, for indexing the blank and locking it after such indexing, as well as an eccentric, W, for operating a brake at the completion of each cutter, and after the disengagement of the driving clutches to be presently described.

The indexing mechanism is partially illustrated at the left of Fig. 10. At the right-hand end of the rod 25 is a friction roller engaged and driven by the cam 18, while directly behind 25, and hidden thereby in this figure, is a similar rod actuated by the cam 38, which slightly precedes 18 in position on J^2. Between the collar 20′ and the fixed arm 26 is the spring 20 for returning the rod 25 to its normal position after the indexing of a tooth is accomplished. The rod for actuating the locking mechanism carries a similar return spring. Through the arm 28 is driven the rod 29, carrying on its inner, concealed end a rack which engages the pinion 21. On the same shaft 23, and engaging with the gear 14 on the blank-carrying mandrel, is a pinion 22, separated from 21 by an ordinary toothed clutch, held in engagement by a helical spring surrounding the shaft 23. Pinion 21 being loose on 23 and 22 keyed thereto, it will be seen that the movement of the rods 25 and 29 in one direction, e. g., to the left, will, by means of the rack and pinions 21 and 22, effect the indexing; while when the spring 20 returns these rods, the clutch between 21 and 22 may be so pitched as to slip and prevent the rotation of pinion 22. The lock nuts R^1 on the rod 29 are so adjusted as to contact with 26 and permit only a limited return of these rods, thus regulating the travel of the rack and the rotation of the indexing mechanism.

The locking mechanism consists of a toothed disk 30 and a spring-pressed pin 31, which is retracted by the cam 38 and a cam-surfaced rod, before mentioned, directly behind 25.

Upon the completion of a cutter, a stop 30″ (Fig. 8) on the disk 30 contacts with a toe on the rod 81 and through the parts 85, 83, 86, 82 and 84 actuates vertically movable wedges, which unclutch both the gear 65 and the pulley P from their respective shafts, stopping the machine. Treadle rods, seen imperfectly near U and U^1, permit the independent unclutching of either or both shafts, as necessity may require.

The face of the forming tool being correctly shaped and its upper edge set so as to strike the blank C^1 radially, each tooth will be correctly shaped and relieved without deforming the one just previously swaged.

Fig. 11 illustrates in isometric and Fig. 12 in vertical section on line 2—2 of Fig. 11, an appliance for centering and drilling studs, short shafts, etc., exactly diametrically and at right angles to their axes, and which is adapted to be used on the work-table of an ordinary drill press, in place of the V's commonly employed for that purpose.

Jigs for special jobs of all descriptions are common enough, but few are capable of the variety of uses of this device, which

is the invention of Mr. F. C. Thielscher, of Boston, Mass.

The frame A, properly supported, is provided with an inverted V slot, in which the work is held by the clamp C and screws d, the clamp, when reversed, being capable of holding work of smaller sizes. D is the drill-guide and centerer, each hole having a diametrical mark, as m,

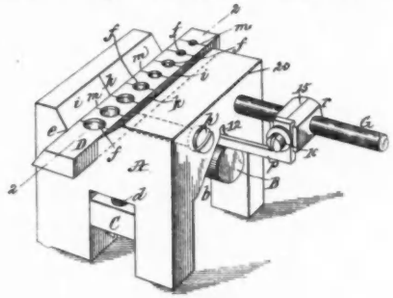

Fig.11.

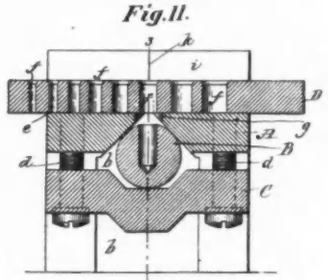

Fig.12.

which may be made to register with an index mark k on the frame, directly above the vertex of the work holding V. G is a stud fixed to the frame and carrying an adjustable guide p, which lies in a groove 12 at the vertex of the clamping V. This attachment permits the setting of shouldered studs and the like and enables them to be drilled at any predetermined point of their length, rapidly and with precision.

Bids on Pumping Engines.

Bids were opened on the 10th at the office of the District Commissions, Washington, for building an 8,000,000-gallon pumping engine in the new "U" street pumping station. The following is the list of the bidders:

George F. Blake Manufacturing Company, Philadelphia, Pa.; $58,150. Time to complete, eight months.

Nordberg Manufacturing Company, Milwaukee, Wis.; $34,895, according to specifications, also $43,310 for an engine of slightly different pattern.

Edward P. Allis Company, Milwaukee, Wis.; $35,000. To be completed by September 10th, 1896.

Arthur J. Loretz, New York, N. Y.; $34,000.

Goshen High-Duty Pumping-Engine Company, New York, N. Y.; $29,000 for horizontal triple-expansion, crank and fly-wheel. The specifications call for a vertical engine. They also sent bids for engines of slightly varying patterns, for $30,990, on or before 300 days, and $32,740.

Henry R. Worthington; $25,990 for triple-expansion high-duty engine.

Holly Manufacturing Company, Lockport, N. Y.; $29,620. To be ready for test in 150 days.

Snow Steam Pump Works, Buffalo, N. Y.; $33,290. To be completed in 300 days.

Pennsylvania Iron Works, Philadelphia, Pa.; $32,500. To be ready for test in 240 days.

Barr Pumping Engine, Philadelphia, Pa.; $29,500 for prescribed pattern; also for different styles of tubes—$30,000 for one, $30,750 for a second, and $31,000 for a third. Either one to be ready within 180 days.

A number of engineers in Chicago have issued an invitation to other engineers and representatives of allied interests, to form a club in Chicago somewhat upon the lines of the Engineer's Club in New York. It is designed to call the new club the "Technical Club"; and to judge from the character and standing of the men who have taken an interest in its formation, it seems likely that the club will be successfully organized and will become one of the features of Chicago, especially interesting to the members of the engineering fraternity. The committee of organization consists of the following gentlemen: Chas. E. Billin, H. F. J. Porter, A. Sorge, Jr., and B. M. Gardner.

COMMERCIAL REVIEW.

NEW YORK, FRIDAY EVENING, JAN. 10.

The outlook, taken all in all, is hopeful in the extreme. From the amount of actual business transacted in various classes of machinery, in the New York district, at the end of last week, one is at first tempted to say that the hopes entertained previous to the holidays have failed of realization. Many sellers of machine tools, engines, etc., feel that the public financial situation, and still remaining uncertainty in regard to international complications, are injuring trade; and it is doubtless true that many orders which were held over until after the holidays are still unplaced, because of the general lack of confidence. Although inventory time may hardly be considered over until the last of the month, buying should, it seems, already be more extensive in the market, were it untrammeled by the influences aforesaid.

But, on the other hand, the volume of business in view is large, and it may be predicted that the unfavorable conditions of trade are superficial, probably transitory, and by no means universal, even at the present time. While portions of the exposed surface of the market stream are retarded by opposing winds, the current in the depths below is following on as steadily as ever. In other words, while hand-to-mouth trade may be suffering from a slight check, the stronger concerns are but little affected; and some manufacturers claim that their business does not suffer in the least. When the contrary gales have blown over, the stream will endeavor to make up for lost time.

Machinery and Supplies.

Some firms find trading in machine tools, in this vicinity, a little slack. There are, however, many inquiries; and certain houses claim that their early business of the year is unaffected by public difficulties. Among them may be cited the New York agency of the Niles Tool Works, which handles machinery of other makes as well. It reports more activity during the first week of January than for any corresponding period for the five years it has been doing business. It is now negotiating with regard to a number of new installations. The situation in the West—Chicago being taken as a center— is better than in the New York district. From another New York house, which is one of the largest in the business, comes the information that there was never before so much prospective trade in heavy machine-tools.

The effects of the boom in machines for bicycle manufacture remain to such an extent, that this is still the leading phase of the tool market. Doubtless, many concerns could report an experience similar in kind, if not in degree, to that of the Cleveland Machine Screw Company, which has enjoyed such a demand for bicycle manufacturing tools and balls for bicycle bearings, that, for some months past, its works have been running 23 hours a day, using two gangs of men. The company has sold all the automatic screw machines it could make, and could probably have disposed of more were it possible to fill orders within a reasonable time. It has been obliged to refuse foreign trade, and is now almost fully provided with orders for machines to be used in the business of 1897.

Prices of machinery are about stationary; but manufacturers claim that they are paying no less for material and wages than hitherto, and that there is a scarcity of skilled labor, owing, more or less, to the activity in bicycle work; so it seems that prices would be sustained, if not advanced.

Wood-working machinery has been very dull in this section, but is now improving, more in respect to inquiry than actual sales, though the latter are somewhat greater than they were. The Berlin Machine Works tell us that they have never—hardly, even in '90 and '91—had so much prospective business in this section as has been coming to light since about the 27th of December. This potential trade is quadruple that of a year ago; but it is yet rather too early for it to become kinetic. In the West and South, however, the actual business has been very flattering. Trade in the New England States, we may add, continues good.

As to the situation in leather belting, the Page Belting Company says: "There will not be much demand until late in January, because mills take inventory this month, and start in at the 1st of February. Prospects seem very good, and there are indications of improvement which lead one to say that, laying aside the bond issue, there will be a demand for belting 20 per cent. greater than a year ago. This we infer from the fact that our December business—which, in general, is indicative of that of January and February—showed for last month, as compared with December, 1894, an increase in the proportion stated. The trade to which we have reference is that of the Middle States, Maryland and Virginia. Hides and Leather are now about normal in price, and the prices of their products have therefore returned nearly to the low figure prevailing in April, before the rise of leather."

Engines, Boilers and Pumps.

These lines of machinery share, to some extent, in the general lack of confidence. Sellers of engines receive inquiries; but they find that some of the fish which have been nibbling at their bait, do not take the hook so soon as expected. Mr. Wood, of the Ball & Wood firm, says that the weak feeling does not reach them, and predicts more confidence, more building and more business. This may be the case with other concerns, which rest upon a sufficiently solid foundation to be unshaken by the minor jars of trade. A house dealing in small engines finds that the Cuban export business is beginning to open up, and that that with Central America is fairly good. Both engines and boilers rule firm in price. In pumps, the feeling of uncertainty so far prevails as to diminish the number of those who buy from other causes than sheer necessity. Some manufacturers are inclined to crowd prices upward.

Motors and Dynamos.

In these lines, orders are coming in fairly well; though sellers admit that the financial situation probably exercises some effect in preventing the closing up of contracts. The Crocker Wheeler Company is tolerably busy, hopeful, and anticipates the early closing of certain orders now under negotiation, but considers it too early to judge of the year's trade. Prices rule stationary.

Iron and Other Metals.

More inquiry has developed in the pig iron market, and, in some quarters of it at least, more actual business. Some fairly good orders have been placed, and sundry large buyers are feeling the market. From the knowledge of one broker, business in prospect to the amount of 40,000 tons was reported. But the outlook is very much clouded, and prices have perceptibly weakened. Alabama producers have come out boldly with the notice of a reduction to a basis of $9, at Birmingham, for No. 1 foundry, the freight to New York being $3.75. Northern irons, also, have been cut. It may be consolatory to remark that the extremely low prices at which small quantities of Bessemer pig have sold in the Pittsburgh market, were apparently the result of bearish manipulation; and that parties who were said to be selling at such marked concessions, when asked for more iron at the same rates, were found to have none they cared to dispose of.

In the metal market there are some signs of reawakening. Tin, during last week, advanced about 35 cents per pound, owing principally to English speculation. There is an improvement in demand, but not all that might be desired.

Copper has been depressed and unsettled. There has been some export trade, and it is believed that consumption this year will be heavy; but extensive production is also anticipated.

Lead is quoted down to a figure which is expected to produce heavy laying in of stocks. The quantity imported from Europe last year is estimated at 20,000 tons.

During the week spelter has displayed some activity; but no very extensive business has taken place.

QUOTATIONS.

NEW YORK, Monday Evening, January 13th

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$13 00@ $13 50
No. 2 foundry, Northern	12 00 @ 12 50
No. 2 plain, Northern	11 25 @ 11 75
Gray forge, Northern	11 75 @ 12 00
No. 1 foundry, Southern	12 75 @ 13 00
No. 2 foundry, Southern	12 25 @ 12 50
No. 3 foundry, Southern	11 75 @ 12 00
No. 1 soft, Southern	12 25 @ 12 50
No. 2 soft, Southern	11 75 @ 12 00
Foundry forge, Southern	11 50 @ 11 75

Bar Iron—Mill price on dock: common, $1.25 @ 1.35; refined, $1.35 @ 1.50.

Scrap Iron—No. 1 yard wrought, f. o. b., $12.50.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—About $1.55 in carloads, mill price. Special brands upward.

Cold Rolled Steel Shafting—Base, 2½c. in carloads; 2¾c. in smaller quantities; 3c. from store.

Copper—Lake Superior ingot, 10c.; electrolytic, 9⅝ @ 9¾c., sometimes shaded; casting copper, 9¼ @ 9½c. for ordinary stock.

Pig Tin—Early deliveries, $13.20 wholesale.

Pig Lead—In carloads, 3c.

Spelter—Western brands, $4.02½ @ $4.05 wholesale, New York delivery.

Antimony—In wholesale lots, Cookson's, 7¾ @ 8c.; Hallett's, 6⅞ @ 7c.; Japanese, 6¾ @ 6⅞c.

Lard Oil—Prime city, present make, 51 @ 53c.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9"X12", 6"X9" and 4½"X6". We recommend the 6"X9" size for machinery catalogs. When they must be larger or smaller, one or the other standard sizes should be adopted if possible.

The Concord Axle Co., Penacook, N. H., send us a catalog illustrating and describing their various styles of axles for vehicles, also springs of various forms, wheel hubs, etc. The catalog is 5¼ x 7⅜ inches, and is mailed to those interested on application.

The Athol Machine Co., Athol, Mass., send us their new 1896 catalog, which describes and illustrates machines and tools for various purposes, among which are, for machinists' use, vises, try-squares, depth gages, bevels, and a variety of measuring and gaging tools. It will be found interesting to mechanics, and is sent to any address on application. It is 6 x 9⅝ inches.

MANUFACTURES

The West End Rolling Mill Co., Lebanon, Pa., has been formed by J. Henry Miller and J. R. Evans, with a capital of $100,000.

The Utica (N. Y.) Drop Forge & Tool Co. has been formed with a capital of $30,000. Incorporators, Wm. M. White and Jno. Campbell.

The Alexander Nut Lock Mfg. Co., of New York, is incorporated. Capital, $200,000. Those interested are M. H. Alexander, Jno. W. Johnston and R. R. Brown.

At Trenton, N. J., the Walker Mfg. Co., of Cleveland, O., has been incorporated by John Ludwig, Charles King and Martin W. Dixon, of Jersey City, with a capital of $2,500,000, for the manufacture of electric generators and motors, and other electrical apparatus.

The New York office of the Pittsburgh Reduction Co. has been removed from No. 4 Havemeyer Building, corner of Church and Dey streets, to Rooms 10 and 11 Havemeyer Building, which are nearer Cortlandt street, and give additional room that was required for the stock carried.

As foreshadowed in a previous account, the machinery stores of the J. A. Fay & Egan Co. and Lodge & Davis Machine Tool Co., in Chicago, are to be consolidated and operated together by the new Davis & Egan Machine Tool Co. The works of the last-named company are being operated over time and additional men will shortly be employed. It is the intention to increase the capacity of the plant.

Mr. James E. Woodbridge, for many years at the head of the Small Tool Department of the Pratt & Whitney Company, of Hartford, Conn., has recently acquired an interest in, and become identified with the Brady Manufacturing Co., of York and Washington streets, Brooklyn, N. Y., as its president. It is now the intention of the Brady Manufacturing Co. to take up the manufacture of a full line of Small Tools of every description, in addition to their regular business of Special Automatic and Labor-Saving Machinery, Special Tools and Fixtures.

The Davis & Egan Machine Tool Co. (formerly the Lodge & Davis Machine Tool Co.) report a rapidly growing export trade in tools. They are making shipments nearly every week to England, have just completed a large order and shipped to Mexico, and will in a few days ship one of their large machines to one of the leading machine shops in Vienna. They have just received an inquiry from a large concern in Buenos Ayres, South America, for a number of their large machines. They also report that the Bicycle business still continues active, and they have closed several good contracts for their tools during the last week.

Darling, Brown & Sharpe, Providence, R. I., write us: "Our sales for 1895 exceeded the anticipations we expressed in writing you a year ago. They not only recovered the loss during the dullness of 1894, but were greater than the sales of 1893. The prices of a number of our tools were reduced, the most notable changes being in the revision of the price list of rules. This list had been unchanged for over thirty years, and we felt that a revision was required, owing to variations in the cost of manufacture and the fact that almost all articles within the past few years were reduced in list as well as in net prices. Our chief success during the year has been the manufacture of a full line of tempered scales, which we are now commencing to place upon the market. For a long time we have desired to do this, but we found that all the processes and machines made for this work produced results which were not up to our requirements, and we accordingly were compelled to devise methods and machines for this purpose. These have proved satisfactory, and we think it of considerable importance to machinists that they can now obtain tempered rules which are as accurate as our standard rules."

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Situation by first-class moulder on green, dry, sand or loam, or as foreman. Box 7, AM. MACH.

Sit. wanted, hyd. and spec. mch. designer; tech. educa.; can take charge room. Box 12, AM. MACH.

Superintendent wanted in a machine screw shop doing considerable bicycle work; only first-class men need apply. "Cleveland," AM. MACHINIST.

Wanted—Fifty first-class machinists, vise-hands, lathe and planer hands. Apply to the Lodge & Davis Machine Tool Co., Cincinnati, O.

Wanted—Foreman for brass foundry; must understand the business; no experimenter need apply. Address Ecaroh, AMERICAN MACHINIST.

Wanted—A good machine tool man as the contractor for the output of entire plant. A good opening for the right man. Box 15, AM. MACH.

A middle-aged man well qualified to design stamping presses and tools, bicycle tools, etc., wants a position. Box 10, AMERICAN MACHINIST.

Comp. draftsman wants pos., exp'd in H. S. eng., four valve eng., water tube boilers, etc.; some experience in designing. Box 13, AMER. MACHINIST.

Mech. d'ft-man, grad., Swede, 6 yrs. exp. in this country, wts. pos., steam eng., st. r'y work, heavy mach.; terms moderate. Box 14, AMER. MACHINIST.

Foreman pattern maker desires a change; 5 yrs. exp. as f'man large concern build. hvy. mch.; has economic methods; age 39. Box 11, AM. MACHINIST.

Tools and dies, up to-date, 35, American; screw machine tools, milling cutters, etc., experienced in hardening, wants position as head tool-maker. Box 9, AMERICAN MACHINIST.

Wanted—A first-class draftsman by one of the largest shops; prefer a man who has had experience on Corliss engine work and heavy machinery. Address Box 162, AMERICAN MACHINIST.

A mechanical engineer, successful designer and first-class draftsman now open for engagement; 20 years' varied experience; specialty, high-grade engines. Address Box 263, Ridgway, Pa.

Position as foreman or supt., by a thorough mechanic, 40 years old; in charge of men the past 12 years; much experience in piece work practice and estimates. Wilson, AMERICAN MACHINIST.

Foreman boilermaker wanted, must be well up on marine and stationary boilers and getting out work to best advantage, highest wages to right man. Address Box 191, AMERICAN MACHINIST.

Wanted—Superintendent of machine shop employing 75 to 100 hands, must have executive ability and push; state exp. and salary exptd. "L," Room 501, Johnston Building, Cincinnati, Ohio.

Wanted—Capable foreman for press room where sheet metal goods are formed and drawn from soft steel; must have experience on D. A. and drawing presses and making tools for special press work. Box 817, Worcester, Mass.

Mechanical engineer, American, age 29, tech. grad., experienced constructor on ice mach'y, Corliss, steam and gas engines, wants position as engineer or constructor; highest class references as to ability and character. Box 8, AM. MACH.

Position wanted, good draftsman and designer, shop exp., experience in charge of millwright crew of large paper mill; especial exp. in power-transmitting mach'y, water-wheel work, mill building and erecting machinery. Address M., AM. MACH.

Wanted—Foreman for assembling department; one who has had large experience on bicycles, both at assembling and machine work; must be competent to handle men and a "hustler." Address with full particulars in regard to experience, wages, &c., George N. Pierce & Co., Buffalo, N. Y.

An experienced molder, who has had ten years' experience in mining machinery, seven years as foreman, is thoroughly posted on chilled iron work, at liberty after March 1, 1896, would like to correspond with responsible firm who need such a man. Address Molder, this office.

MISCELLANEOUS WANTS.

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Wanted—Design for a gas engine; will buy or manufacture under royalty. "S. E.," AM. MACH.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Wanted—Second hand shaper, 15″ stroke preferred; second-hand lathe, 12″ to 14″ swing, 6′ bed. Ann Arbor Mfg. Co., Ann Arbor, Mich.

Wanted—Concern controlling modern machine shop and foundry to build sectional water tube boilers. Address "Boiler," care AM. MACHINIST.

Machines at low price. Small engine lathes, foot lathes, drills, saws, printing presses, etc. An assortment of first-class tools. We buy, sell and exchange. Wallace H. Mansfield, New Haven, Conn.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

Buyers' Finding List.

Balls, Steel.
Cleveland Machine Screw Co., Cleveland, O.

Belt Dressing.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Bicycles.
Fenton Metallic Mfg. Co., Jamestown, N. Y.

Bicycle Supplies.
Haines Co., Wm. J., Philadelphia, Pa.

Blowers.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Cooke & Co., New York.
Roots, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston, Mass.

Boilers, Steam.
Orr & Sembower, Inc., Reading, Pa.
Sterling Co., The, Chicago, Ill.
Watts-Campbell Co., Newark, N. J.
Weston Engine Co., Painted Post, N. Y.

Bolt Cutters.
Acme Machinery Co., Cleveland, O.
McCabe J. J., New York.
National Machinery Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Books, Technical.
Baird & Co., Henry Carey, Philadelphia, Pa.
Grant, Geo. B., Lexington, Mass.
Open Court Publishing Co. Chicago, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.
Wiley & Sons, John, New York.

Brazing Wire.
Haines Co., Wm. J., Philadelphia, Pa.

Calipers.
Brown & Sharpe Mfg. Co., Providence, R. I.
Standard Tool Co., Athol, Mass.
Starrett, L. S., Athol, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Wilkinson & Co., A. J., Boston, Mass.

Castings, Iron.
Builders Iron Foundry, Providence, R. I.
Burr & Houston Co., Brooklyn, N. Y.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Shriver & Co., T., New York.

Castings, Steel.
Johnson Co., The, Johnstown, Pa.

Chucks, Drill.
Almond, T. R., Brooklyn, N. Y.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt Chuck Co., Clayville, N. Y.
Skinner Chuck Co., New Britain, Conn.
Trump Bros. Machine Co., Wilmington, Del.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Whiton Machine Co., D. E., New London, Conn.

Chucks, Lathe.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
National Chuck Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Pratt Chuck Co., Clayville, N. Y.
Skinner Chuck Co., New Britain, Conn.
Whiton Machine Co., D. E., New London, Conn.

Clutches, Friction.
Brown, A. & F., New York.
Evans Friction Cone Co., Boston, Mass.

Condensers.
Conover Mfg. Co., New York.
Worthington, Henry R., Brooklyn, N. Y.

Cranes.
Harrington, Son & Co., E., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Speidel & Roeper, Reading, Pa.

Cutting-Off Machines.
Armstrong Mfg. Co., The, Bridgeport, Conn.
Hurlbut-Rogers Machine Co., So. Sudbury, Mass.

Dies, Screw Cutting.
Acme Machinery Co., Cleveland, O.
Besly & Co., Chas. H., Chicago, Ill.
Carpenter, J. M., Pawtucket, R. I.
Jones & Lamson Machine Co., Springfield, Vt.
Montgomery & Co., New York
Pratt & Whitney Co., Hartford, Conn.
Strelinger & Co., Chas. A., Detroit, Mich.
Taylor-Rice Engineering Co., Gloucester City, N. J.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drawing Instruments, Etc.
Alteneder & Sons, T., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Machines.
Aurora Tool Works, Aurora, Ind.
Barnes Co., W. F. & John, Rockford, Ill.
Baush & Sons, C. H., Holyoke, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Blaisdell & Co., P., Worcester, Mass.
Dallett & Co., Thos. H., Philadelphia, Pa.
Davis, W. P., Rochester, N. Y.
Dawson & Goodwin, Chicago, Ill.
Dietz, Schumacher & Co., Cincinnati, O.
Drilling Vise Co., The, Chicago, Ill.
Dwight Slate Machine Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Fox Machine Co., Grand Rapids, Mich.
Garvin Machine Co., New York.
Harrington, Son & Co., E., Philadelphia, Pa.
Lodge & Davis Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Montgomery & Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Stover Novelty Works, Freeport, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.
Timolat, J. G., New York.
Warner & Swasey, Cleveland, O.
Wilkinson & Co., A. J., Boston, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Twist.
Besly & Co., Chas. H., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Montgomery & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.

Drop Forgings.
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Dynamos.
Roth Bros. & Co., Chicago, Ill.

Elevators.
Albro-Clem Elevator Co., Philadelphia, Pa.

Continued on page 26.

BUYERS' FINDING LIST—Continued.

Emery Wheels.
Besly & Co., Chas. H., Chicago, Ill.
Montgomery & Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Sterling Emery Wheel Co., Tiffin, O.

Engines, Gas and Gasoline.
Backus Water Motor Co., Newark, N. J.
Otto Gas Engine Works, Philadelphia, Pa.

Engines, Steam.
Ames Iron Works, Oswego, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Ide & Son, A. L., Springfield, Ill.
Keystone Engine and Machine Works, Philadelphia, Pa.
Orr & Sembower, Inc., Reading, Pa.
Watts-Campbell Co., Newark, N. J.
Weston Engine Co., Painted Post, N. Y.

Feed Water Heaters and Purifiers.
National Pipe Bending Co., New Haven, Conn.
Taunton Locomotive Mfg. Co., Taunton, Mass.

Files.
Besly & Co., Chas. H., Chicago, Ill.
Montgomery & Co., New York.
Nicholson File Co., Providence, R. I.
Strelinger & Co., Chas. A., Detroit, Mich.

Flexible Tubing.
Almond, T. R., Brooklyn, N. Y.

Friction Cones.
Evans Friction Cone Co., Boston, Mass.

Furnaces.
American Gas Furnace Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.

Gauges.
Brown & Sharpe Mfg. Co., Providence, R. I.
Coffin & Leighton, Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Taylor-Rice Engineering Co., Gloucester City, N. J.

Gear Cutters.
Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Grant, Geo. B., Lexington, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whiton Machine Co., D. E., New London, Conn.

Gears.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant, Geo. B., Lexington, Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co., T., New York.

Graphite.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grinders, Centre.
Barker & Co., William, Cincinnati, O.
Leland & Faulconer Mfg. Co., Detroit, Mich.
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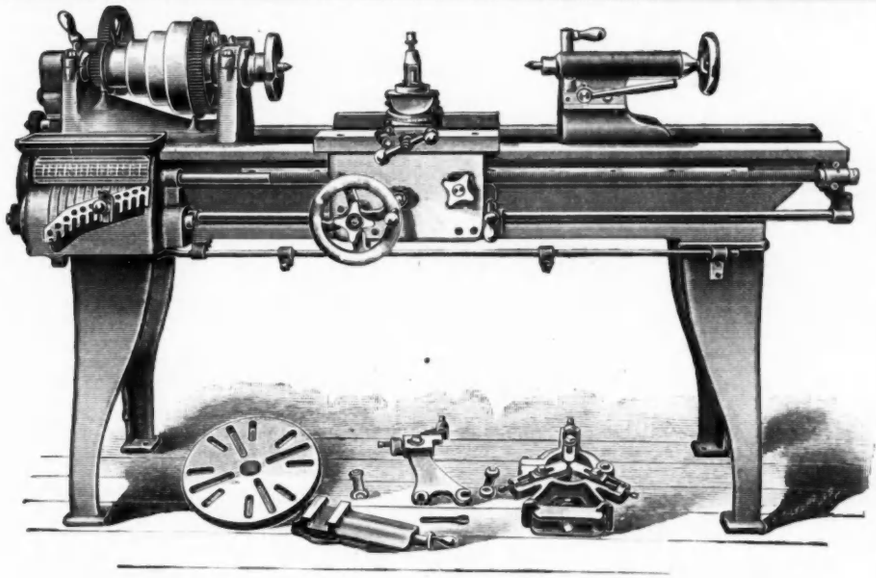

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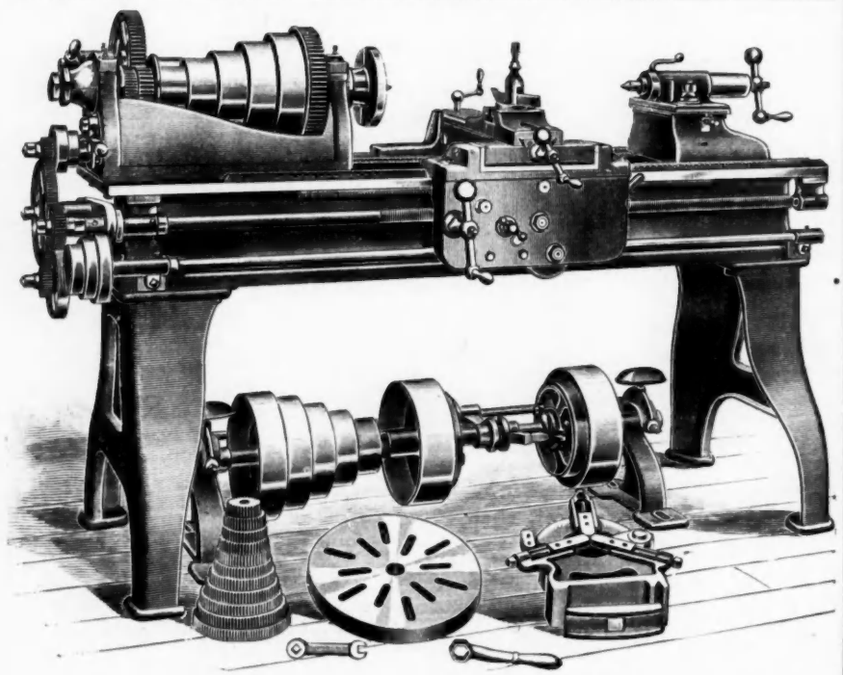

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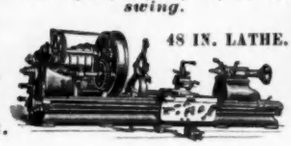

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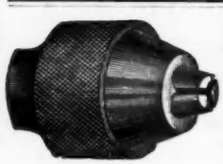

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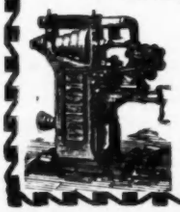

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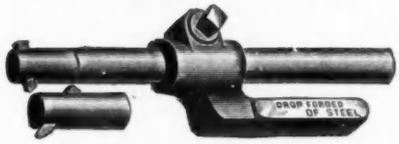

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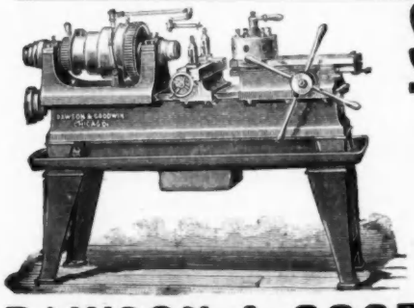

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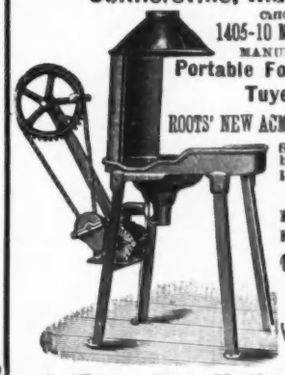

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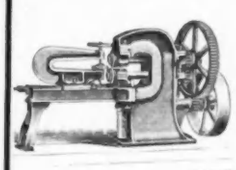

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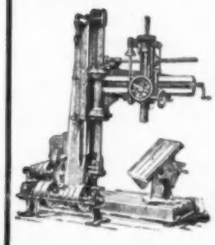

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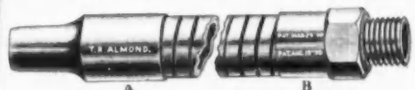

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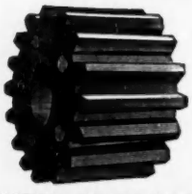

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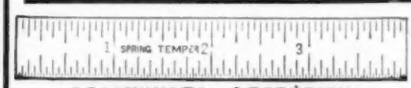

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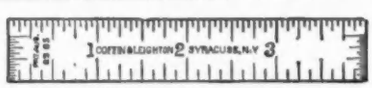

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